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A UNIQUE AND FAMOUS FRENCH OBSERVATORY.

CHARLES NEVERS HOLMES.

The Observatory at Juvisy in France is both unique and famous, chiefly because it is the astronomical headquarters of the great French astronomer, Camille Flammarion. This remarkable man was born at Montigny-le-Roi in 1842 and has, therefore, passed the three-score and ten years allotted to most of us by the Psalmist. But M. Camille Flammarion has forgotten evidently all about this fact, being today more actively energetic than many men not yet two-score years of age. And indeed his whole life has been energetically and profoundly intellectual—a life that will be devoted for years to come, in all probability, to probing into and philosophizing upon the amazing secrets of our illimitable Cosmos.

The "Maître", as his astronomical colleagues love to call him, entered the Paris Observatory in 1858, worked for four years in the *Bureau des Longitudes*, and afterwards was editor of the *Cosmos* and the scientific department of the *Siècle*. His first book was written in 1862 (*La Pluralité des Mondes Habités*), which reached its 34th edition in 1890; and *Les Merveilles célestes* (1865), *Etudes et Lectures sur l'Astronomie* (1867-80), *Voyages en Ballon* (1868), *Lumen* (1873), *Catalogue des Etoiles Doubles* (1878), *Astronomie populaire* (1880), *Les Etoiles et les Curiosités du Ciel* (1881), *Urania* (1889), and *La Planète Mars* (1892), as well as numerous other astronomical writings, followed. His work in the founding of the Astronomical Society of France (1887) is well known and its chief publication, *L'Astronomie*, is indeed a highly instructive and interesting periodical. M. Flammarion is also famous, as everyone knows, as a very successful and very brilliant popularizer of astronomical subjects.

The Observatory at Juvisy, near Paris, was founded by M. Flammarion, wholly from his own financial resources, in 1883, thirty four years ago. It is, therefore, in every sense, his own observatory, and it is very fitting that it should be named "Observatoire Camille Flammarion". The observatory is, of course, well equipped with all necessary astronomical apparatus, and contains in its archives innumerable and invaluable astronomical records. Although as in most observatories there is a general observation of the firmament and a general consideration of the many problems of our Cosmos, the astronomers at the Observatory of Camille Flammarion have devoted much study to the investigations of astrophysics, the planets, especially Mars and Jupiter, and to the photographic and spectroscopic investigation of star-masses and nebulae. As viewed from the front this unique observatory resembles somewhat a combined castle and palace, although the telescopic dome upon its roof modifies a little one's first opinion respecting the building. However, the Observatoire Camille Flammarion is indeed very impressive and very picturesque. Over its gateway there are engraved these words, "Ad Veritatem Per Scientiam," with a star placed most appropriately below them. It is both an observatory and a home, these astronomical headquarters of M. Flammarion, and the home-part of the building, in its rear, looks certainly most comfortable and old-fashioned.

The Observatoire Camille Flammarion at Juvisy, with its invaluable records and traditions, should be permanently established as a memorial to its founder. It is so unique and famous—there are too few such peculiar institutions for it to be neglected and forgotten. Certainly there should be some wealthy person in France, England or the United States to establish this remarkable observatory as a future memorial to a great and famous astronomer.

Newton, Mass.
41 Arlington St.

TRUE GREATNESS.

See yon star of silv'ry ray;
How at dawn it fades away!
But the night will bring anew
All its light of silver hue.

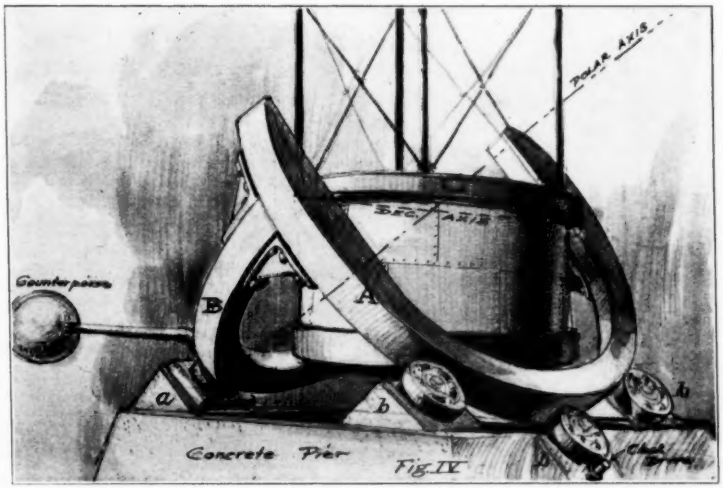
Thus may deeds of greatness cease
At the dawn of gentle peace,
But the night of strife and pain
Brings their lustre back again!

E. E. BARNARD. 1880.

A NEW FORM OF MOUNTING FOR LARGE REFLECTORS.

RUSSELL W. PORTER.

With the increase in size of telescopes difficulties of flexure arise that become very bothersome. In the fork form, even with the heaviest of castings, the fork will bend in all positions of the instrument. With the declination axis horizontal the bending produces its maximum effect (Fig. *I*) and stars will shift on the plate the entire amount in declination, of the angle *a*. When the declination axis is in the meridian (Fig. *II*), the flexure is there just the same, but so applied as not to shift the field of view.



Therefore the yoke is resorted to. The telescope tube is hung between the two bearings instead of outside of them as in Figure *III*, but it will be seen that in order to gain this rigidity a part of the northern heavens has had to be sacrificed. The writer submits a mounting wherein extreme rigidity is found and the entire heavens retained.

The axle of the polar axis disappears. Rather, the upper bearing is expanded to the size of the equatorial ring, see Figure *IV*, which is a perspective drawing showing the position of the instrument when

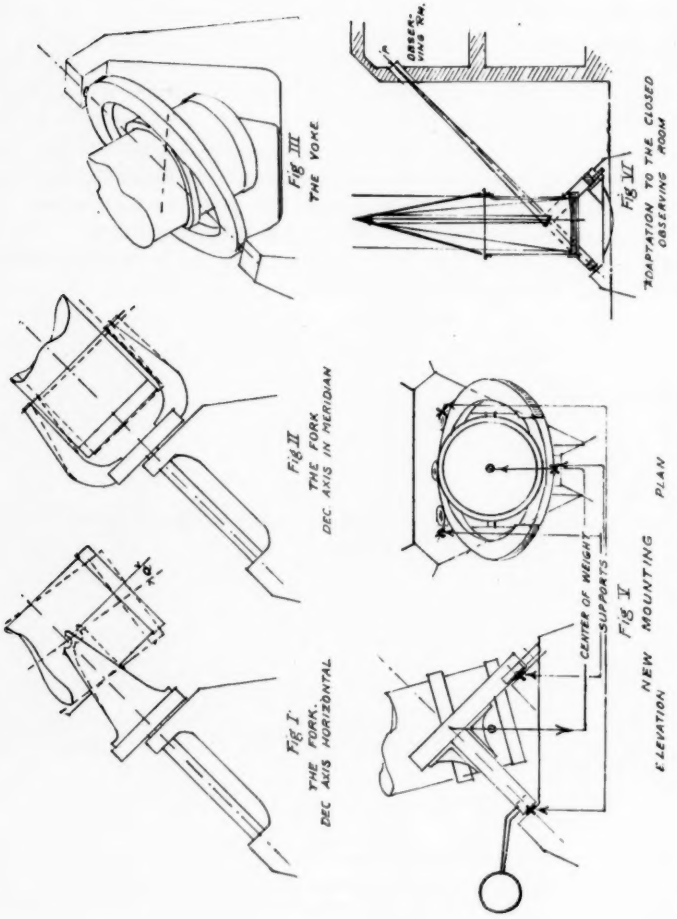


Fig I
THE FORK.
DEC AXIS HORIZONTAL
Fig II
THE FORK
DEC AXIS IN MERIDIAN
Fig III
THE YOKE
OBSERVING RM.
Fig VI
ADAPTATION TO THE CLOSED OBSERVING ROOM
CENTER OF WEIGHT
SUPPORTS
Fig V
NEW MOUNTING
ELEVATION
PLAN

directed at the zenith. This equatorial ring *A* rests on rolls or ball bearings *b*, *b*, distributed around its rim. To the equatorial ring is bolted the ring *B* which in this case is an hour circle with its thrust bearing in the polar axis at *a*. Inside the equatorial ring is swung the declination ring *C*, carrying the tube and optical train. One quarter of ring *A* is cut away to allow the tube to swing clear from horizon to horizon. The only counterpoising is to restore the symmetry about the polar axis, disturbed by the removal of this part of ring *A*.

The following advantages for this mounting may be noted. Extreme compactness of form, the center of weight being low and within the supports, Figure *V*; the powerful leverage obtained for applying the clock drive at the rim of ring *A*; a minimum of counterpoising; and all parts of the sky accessible.

Such a mounting, if desired, can be adapted to a closed observing room, Figure *VI*, by converting it to the Cassegrainian form, and adding an extra reflection as in the Common mounting at Harvard.

The diameter ratio of equatorial to declination rings is 3/2, so that for a four foot speculum ring *A* would be six feet in diameter. It might also be noted that the instrument becomes most stable,—that is, its center of weight falls midway between its three point support,—in our middle latitudes. It would be impracticable at the poles or equator.

Land's End Observatory,
Port Clyde, Maine.
Nov. 21, 1917.

A PERFECT NIGHT.

No Moon and not a cloud—a perfect night!
A coal-black sky with gleaming gems aglow,
A darkling earth when knolls and dales are white,
Enwrapped in raiment of untrodden snow.

Amidst yon firmament's bespangled span
Capella blazes like a beacon's light
Above the glare of red Aldebaran
Or Pleiades that glitter small and bright.

There Procyon is sparkling all alone,
Orion's jewels are a gorgeous sight,
And Sirius is reigning on his throne,
Undimmed as years and cycles take their flight.

And where the higher sky-gems gleam and glow
There softly shines a golden satellite
O'er snow-bound knolls and dales that sleep below,
Ere Moon has risen on this perfect night.

CHARLES NEVERS HOLMES.

Newton, Mass.,
41 Arlington St.

WHAT WAS THE STAR OF BETHLEHEM?

STANSBURY HAGAR.

What was the Star of Bethlehem? Must we accept the popular view that it was a miraculous light which first appeared in the heavens at the moment of Christ's birth, advanced before the Magii as they journeyed to his cradle, stood still above that sacred spot and then disappeared forever? Whatever may be its meaning certainly no other story of the heavens has aroused such interest in Christendom and, therefore, none so much requires explanation. Even many to whom the miraculous has lost its appeal seem to cling to this star story, more or less unconscious of its supernatural elements, perhaps because of its poetic beauty. But to those who seek the real significance of the star the writer wishes to present a novel interpretation which he hopes will not be found lacking in idealic beauty and grandeur. This interpretation is not associated with any system of theology, although it will be shown that it can itself be explained, as the reader prefers, in accord with orthodoxy, liberal religion or scepticism. Whatever viewpoint be adopted the result will not accord with the Sunday school scholar's definition of an allegory as a heavenly story with no earthly meaning. And if the reader will recognize that the value and truth of the teachings of a great Master of spiritual law are independent of the literal truth of the incidents attached to his life, nothing herein will antagonize him or her.

The interpretation is based upon astronomy, not the modern scientific astronomy of the telescope, spectroscope and camera, but the astronomy of the period of naked eye observation when every camel driver of the desert caravans and every shepherd in the fields watched in awe the mysterious lights of the night sky and the priests studied the heavens in ceaseless search for every secret that the unaided eye could reach. And then the imagination of the Orient took the knowledge thus acquired and wove it into poetic legends of the sky, true in basic meaning but veiled in imagery. It is this poetic symbolism of astronomy which we must seek to understand, a symbolism elementary in the Oriental mind but foreign to the modern Occidental habit of thought. We have interpreted the Star of Bethlehem literally in harmony with our viewpoint; really to understand it we must interpret it from the viewpoint of the time and place to which it refers.

Early paintings in European cathedrals depict the Lord in the act of hanging out the sun, moon and stars upon the sky with his own hands and this was the literal belief of the time.* In this naive stage of thought the miracles connected with the Star of Bethlehem were naturally accepted without question. But when the rise of modern science put an end to the age of signs and wonders in the heavens and established the omnipresent and omni-temporal reign of natural law, supernatural explanations ceased to be acceptable to the progressive intelligence of the race. Numerous attempts were then made to place the Star of Bethlehem upon a purely rational basis. The supernatural was discarded in favor of some natural but unusual phenomenon occurring only at the time of the Nativity or recurring only after a long or irregular interval. The star became a comet, meteor, meteor shower, northern lights, a planet in some conspicuous position, conjunction of planets, a dream of the Magi.† Any one of these phenomena and numerous other conspicuous celestial apparitions might have occurred at or near the required time, but it is not certain that they did occur then and if they did no satisfactory evidence connects them with the Star of Bethlehem. Again if they did occur there should have been no difficulty in describing them definitely.

The truth is that the seed whence grew the Star of Bethlehem was planted away back in prehistoric times in the soil of the first primitive attempts to determine a date by means of the celestial clock upon the face of which the stars served as hands. To understand the nature of the fruit therefore, we must study its growth from the beginning, paying attention first to primitive time measures, then to their development into the elaborate systems in vogue in the countries in and around Palestine near the beginning of the Christian era. We should then compare certain features of these systems with certain elements of the Star of Bethlehem story in order to determine whether or not the latter may be traced back to a common origin and significance.

How many of us have thought of the great influence that the measurements of time and the seasons, and later the determination of a date, has had upon the development of the human mind? Primitive man used no time measure. He ate whenever he could obtain food, slept whenever sleep came upon him, paid no attention to the seasons and perhaps little even to the recurrence of day and night. Therefore, he provided against neither the heat of noon nor the cold of night, nor stored up food or clothing against the winter. He suffered accordingly, until this very suffering, his most primitive teacher, furnished the

* A. D. White. New Chapters in the Warfare of Science, Vol. I. p. 1.

† See Hans Herman Keitzinger. Der Stern des Weisen.

stimulus that led him to foresee and provide against its recurrence. At first it sufficed him to know that night follows day and winter follows summer in an unending round; but by and by he wished for more definite information as to particular seasons. Among the first time measures, the hunter wished to learn the most favorable season for seeking his prey. He found nothing on earth that could help him obtain this knowledge with sufficient accuracy. Then he looked above at the starry heavens, and sought there for aid. First he noted that the star groupings are unchangeable, and that certain groups return to the same position in the sky with the return of a certain season; and among them, one of the most remarkable groups occupied a conspicuous position just at the best hunting season. In this way he came to connect these stars with hunters and hunting, and thus the group became the stars of the hunter all over the world, wherever a similar climate prevailed. Since they were always associated with the hunt, the hunter began to attribute to them power over the game, to bring it to him or to warn it away; and so he sought to propitiate these stars by various offerings and by dances held during the hunting season, in which the dancer explained to the stars by his movements that he wished their aid in discovering and overtaking the game; and then, by a curious inversion, to account for this ritual it came to be thought that there was a giant hunter in those stars who would aid human hunters if they appealed to him. Numerous tales were invented about his power and mighty prowess. Thus the legends of Orion, the celestial hunter come down to us from primitive sources, lost in distant antiquity. Thus was the celestial clock discovered, and thus arose celestial ritual and myth, world-wide in distribution; but it all began with the attempt to determine a season.

Another step forward, and the star group is followed in its varying positions throughout the year, so that it marks four seasons instead of one. An interesting example of this still primitive time measure is found among nearly all the Indian tribes of the United States east of the Mississippi. A group of stars in our constellation of the Great Bear, with those of the Northern Crown and a few neighboring stars in other constellations, form the Indian group of the Bear, his Den and the Seven Bird Hunters. The legend tells how the bear comes out of his den in spring, runs across the sky in summer, is overtaken and killed in fall, when the breast of the robin becomes eternally covered with his blood; and the blood which falls upon the trees of earth produces autumn foliage. In winter the bear lies asleep, invisible in his den, to again issue forth in spring and so to repeat the eternal round. Each of the four positions of the bear in the story corresponds accurately

with the position of the stars of the Bear during the early evening in that season only, showing that this group has been used by the Indians as a seasonal time-marker.*

The stars of the Southern Cross were similarly used by the Indians of South America. These rough time measures sufficed for primitive hunters; but when hunting was superseded by agriculture, a more exact method became necessary to determine the proper time for sowing and reaping the crops. Then it was discovered that a certain group of stars, not particularly conspicuous but unique in appearance, occupied such a position in the sky that it rose directly before sunrise, at sowing time, and just after sunset at harvest time. Thus the Pleiades became the time markers in the earliest agricultural year of two seasons. This Pleiades year spread over the entire world, and produced some very important results with which we are directly concerned. Just as Orion became associated with hunters and game, so the Pleiades became the stars of the farmers and the crops; and to them was attributed supreme power over vegetation. They protected the seed when it was deposited in the ground, caused it to germinate and grow, brought the nourishing rains in the proper season, and ever sought to provide an affluent harvest for man. The coast tribes of Peru believed that the Pleiades had created their crops, and they accused their Spanish conquerors of base ingratitude because they failed to worship these most benevolent stars. So, as the stars of the rains and crops, the Pleiades came to be regarded as of all the stars the most beneficent towards man, because they watched over and increased his food supplies. Consequently, there grew up around them the most numerous and elaborate rituals and myths that are associated with any star group. They were the patrons of all sowing and harvest dances and the home of blessed spirits friendly to man. As the stars of spring, the Latin Vergiliae, dominating in past milleniums the vernal morning skies, they ushered in the season of joy and light and life, when all nature wakes from its winter sleep. So pre-eminent became their position in early mythology that they were used as the symbol of the entire starry host of heaven; and all this they owed primarily to their use as markers of time and the seasons.

Another pretty idea became associated with them. Some of our Indian tribes describe the stars as camp-fires burning before the wigwams in the land of the sky; and their flickering is caused by the movement of dancers eternally dancing the ritual dances around them. Very likely this is the primitive idea from which was evolved the conception that the whole celestial revolution is a cosmic procession, a

* Hagar, in "Journal of Am. Folk Lore," Vol. XIII. pp. 92 et seq.

stately religious and ceremonial dance of the stars, marking the eternal rule of peace, law and order throughout the cosmos, and accompanied by celestial music which can be heard by ears attuned to the harmony of the spheres.*

As Lucian writes, "The choral dance of the stars, the orderly concert of the planets, their common music and harmony of motion constitute the exhibition of the Dance of the First Born."† Lucian lived in post-Christian times, but recorded ancient traditions. His "First Born" was probably the sky deity. Callimachus, describing the Grecian form of dance myth, writes that the Pleiades, daughters of the Queen of the Amazons, were the first to institute the circular dance, and the Pannychis or watch night, which probably refers to the determination of a date by observation of the stars.‡

Now this celestial dance was also based on the passage of time even in the primitive epoch; and the Pleiades were pre-eminently the time markers. The Hindus, for example, called them the spinners or weavers of the web of measured time. It is easy to understand, therefore, why they also became the pre-eminent celestial dancers; and if, on some clear night, we watch the twinkling of their closely grouped stars, we

FIG. 1. PLEIADES DANCE. (VEDDER. BOSTON PUBLIC LIBRARY.)

shall be convinced that they are indeed dancers, as the Susis of Morocco and our Eastern Indians called them; and then we shall better understand the symbolism of the Pleiades Dance, suggesting the whole

* See R. Brown, Jr. "Euphratean Stellar Researches."

† See J. P. Knight "Sym. Lang. of Anc. Art & Myth, p. 138 note 721.

‡ See J. P. Knight, p. 54, note 186.

cosmic revolution which Vedder has represented for us in his painting in the Boston Public Library; but to the writer, it would seem more appropriate if the beautiful imagery of this cosmic dance of eternal peace and harmony were pictured wholly immersed in the heavens and apart from all material elements, instead of standing on a solid firmament.

Early in primitive times, though probably not till after the constellations had been used to determine the seasons, man observed that the moon and the few stars that moved independently of the starry host always followed the same path among the fixed stars, and that between every full moon and the next, the moon advanced an equal distance along the path in addition to its revolution around the sky. He further observed that after something over twelve such advances, the moon came back to the spot from which it had started, and the seasons repeated themselves in approximately the same period. This gave him the twelve months and the lunar year, practically his first continuous time measure. He divided the stars along the moon's path into twelve constellations, each covering approximately the distance advanced by the moon in a lunar month; and he assigned to these constellations, names based partly upon the configuration of their stars and partly upon their seasonal attributes. So, for example, just as Orion governed the hunting season, and the Pleiades the sowing and harvest seasons, the corresponding constellations of the path became respectively twin hunters and the domestic bull of the fields and pastures. The greater part of these star groups were assigned to animals, and so the band or path in which they were located became known as the zodiac, or zone of animals. Each one of the twelve divisions was called a sign, probably because it served as a marker of time and the lunar progress. Rituals and myths associated themselves with these as with the older constellations in similar manner and with similar purpose.

The sun was not used directly as a time marker until a later period, because his disk is too bright to be gazed at and because he leaves no visible mark like a fixed star to serve as a milestone upon his journey across the sky; but his progress was measured by the movement of the shadows he created, for these could readily be observed, and their advance could be measured upon the surface of the earth. At first the shadows of natural landmarks were used for the purpose. Then artificial objects were erected as shadow casters, and thus appeared first the gnomon, and then the sun dial. Out of the latter were probably evolved our clocks and watches, the hands being substituted for the shadows.

Sir Norman Lockyer and Mr. Penrose have shown that the principal use of many of the most important Egyptian temples was to mark a certain date by means of the rays of the rising or setting sun or of some star that once each year for a few moments only penetrated through the main pylon of the temple and illuminated an altar in the dark Habenben or Holy of Holies at the farther end. The same system was used in Greek temples and in early Christian churches the center aisle was directed to the sunrise point on the day of the saint to whom the edifice was dedicated. This refinement of the gnomon affords further evidence both of the importance attached to the accurate determination of a date, and of the close association of the dates so determined with the religious festivals.

The next step forward in the use of the sun as a time measure concerns us greatly. It was realized that the stars do not actually disappear by day, but are only obscured by the light of the sun. Observation of the zodiacal constellations rising and setting after sunset revealed that these stellar risings and settings advanced through one sign each month. Early students of the sky deduced from these two facts that the sun himself in his apparent journey across the sky travels over the same zodiacal path, followed by the moon and the planets. The power and brilliancy of the sun had from the first ensured his position as the chief divinity of the sky. Hence he was now given the post of honor formerly conceded to the moon as the principal celestial marker of time, and thus the solar zodiac arose. By means of this zodiac any date was fixed by reference to the position of the sun in the zodiac at that time; and this position was determined first by observing the zodiacal stars rising and setting at sunset as above stated, and secondly by noting the whole aspect of the zodiac at midnight, and locating the sun exactly opposite the stars crossing the meridian at that moment. This was the highest and most accurate as well as the final step in the measurement of time and the determination of a date by means of celestial observation with the unaided eye. It had been taken in many parts of the world in prehistoric but not in primitive times. The American Indians and, doubtless, all peoples advanced above savagery, deified not the visible orb of the sun, but the invisible power behind it. Around the sun grew up a wealth of ritual and myth consistent with the importance of his observed influence in lighting and heating the world, in warring against darkness and cold, in bringing the seasons, the rains and the winds. His daily journey across the sky suggested in early times the journey of man through life. Born in the golden east at break of day, he climbs upward in the sky. Clouds war against him on his way; but he overcomes these powers of darkness and passes upward to the zenith of

his power; but there the ascent ends, and thence with waning strength he descends, until old age leads his tottering footsteps into the darkness of the western grave. The powers of darkness have conquered again, and the sky is red with the blood of the murdered god of light. But he will come again in glory, triumphant over darkness and the grave.

Such is the story of the solar myth found in all times and in all parts of the world, and varying but little whenever or wherever found. It was applied also to the annual solar journey. Born as a feeble infant at the winter solstice at the southernmost point of his course, he increases in strength and stature as he advances northward, till at the vernal equinox the days become longer than the nights, light has triumphed over darkness, the Lord of good has overcome the powers of evil and has brought back again the season of light and life. Still he advances northward, increasing in strength till at the summer solstice he attains the height of his power in the northern hemisphere. In the myths this point is marked by miraculous evidence of his supreme strength and power; but now the southward course begins again, and at the autumnal equinox the nights again become longer than the days and the powers of darkness conquer and slay the god of light. Four great festivals mark these four epochs of the solar round—that of birth at the beginning of winter, that of the triumph of light and life at the beginning of spring, that of greatest power at the beginning of summer and that of death at the beginning of autumn. They have reached us as Christmas four days after the winter solstice, Easter determined by the date of the vernal equinox, St. John's Day four days after the summer solstice and the three days festival of death, Hallow Een, All Saints and All Souls. True the last festival is now observed a month later than the autumnal equinox, possibly because it was so closely connected with the death symbolism of the zodiacal constellation of the Scorpion, that it remained attached to this asterism instead of following the sun when the movement of precession had carried the Scorpion back from the equinox. But we need not follow this side track farther.

We have now traced an outline of the early primitive time measures and their development into more elaborate methods, we have seen the increasing importance attached to the determination of a date in later times evidenced by the increasing complexity and accuracy of method an the increasing effort associated with it, and we may have observed and increasing intimacy between the use of the time measures and the religious festivals connected with them. Let us now step forward to the centuries immediately preceding the beginning of our era. Let us limit our field principally to the countries of Egypt, Asia Minor and Greece, which intimately influenced the writers of the New Testament,

and, confining our attention to the festival of birth in those times and regions, let us note into what the determination of a date and the symbolism connected with it had developed with the advance of civilization.

We are concerned first with the famous temple of the goddess Hathor at Denderah in Egypt. The tradition connected with this temple, whether true or not, is a veritable romance of astronomy. About 4200 B. C. the astronomer, architect and King, Khufu, who built the Great Pyramid, is said to have mastered the movements of the heavens and

FIG. 2. PLANISPHERE OF DENDERAH.

to have ascertained that the precession of the equinoxes would bring a certain bright star into close proximity to the northern pole 800 years after his time. He thereupon selected a spot upon which he determined that a temple should be built when the star approached the pole. He planned the temple in detail and deposited the plans in a secret crypt. The cornerstone was to be laid at midnight upon the night of the summer solstice, thus marking the date of the birth of the Egyptian

year. At the appointed time eight centuries later the plans were exhumed by King Pepi who verified the position of the polar star and erected the temple as directed. This was the first temple of Hathor at Denderah. The edifice was altered and extended about 1500 B. C. and was rebuilt again later, being completed in its present form probably during the first century B. C. Denderah is a corruption of Tanterer, Place of the Orbit or Zodiac, and two of the best known zodiacs of antiquity were placed within it, though they were more properly called planispheres because they included other than zodiacal constellations. The name of the goddess Hathor is translated Habitation of Horus, the Divine Light, her son. To him under the name Har-sem-te-we, Horus of the Two Horizons, and to her the temple was jointly dedicated. She was known as Queen of Heaven, Celestial Virgin, Mother of God. It is evident that in early times she was associated with the bright star shining at the pole but evidently, after precession had carried that star away from the pole again, she was transferred to the Virgin of the Zodiac. On the circular planisphere of Denderah we perceive her in that position in the zodiacal sequence, seated in a chair and holding her divine child upon her lap. The third Egyptian month of Shait, roughly corresponding with our September, was dedicated to her.* During this month two milleniums ago the sun was actually passing through the constellation Virgo.

(*To be Continued.*)

IN MEMORIAM: PERCIVAL LOWELL.

Sought by his fellows: showered with fortune's gifts,
He left the world; he turned another page,
From luxury and art the setting shifts
To solitude; a prophet's hermitage.

Above the clouds, above the petty things
Of city mists,—"through hardships to the stars,"—
He heard each star-soul that to star-soul sings
And heard his name called by the soul of Mars.

He brought to earth the message, ere he went
Himself, to verify his eager quest,—
"Thou art but one sphere of the firmament,
Live worthily of all the shining rest!"

Child of the gods, he tiptoed up to look
Furthest of all in their celestial book.

ISABELLE HOWE FISKE.

Wellesley Hills; Mass.

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* See Maspero, Dawn of Civilization, p. 208.

RELATIVIVY IN ASTRONOMY.

W. CARL RUFUS

The Einstein theory of general relativity deals with space-time systems for cördinating physical phenomena. It assumes that the laws of nature, mathematically expressed, must remain invariant for all transformations of coördinates. Many striking and far reaching deductions follow, which have important astronomical consequences. We shall approach the subject from the astronomical point of view.

Various systems of space cöordinates and different methods of time measurement have been used by astronomers to define the motion of a celestial body. The Ptolemaic theory of celestial motions, second century A. D., assumed a stationary earth in the center of the universe, which revolved about it. Fourteen hundred years later Copernicus published the theory that the sun is the motionless center, about which the earth and other bodies revolve. Herschel's theory, that the sun and attendant planets travel through space toward the constellation Hercules, has received recent verification, slightly changing the direction toward the boundary of Lyra, and assigning a velocity of approximately 20 kilometers per second. Thus the assumed criterion of position in space has changed during eighteen centuries from the earth to the sun and thence to the stars. The next criterion has appeared on the horizon,—the spiral nebulae! Their large number, estimated at 500,000, their high velocities, some exceeding 500 kilometers per second, one with record speed of over 1000, and the theory that they are distant stellar universes, offer a basis for the determination of the velocity of our own sidereal system. How tenaciously we cling to the assumption that a final frame of reference may be found!

Various systems of time-reckoning have also held their sway. Numerous mechanical devices to control the rate of motion have been invented to determine the flight of time. The clepsydra and hour glass of the ancients, the balance, weight and pendulum clocks of medieval times, the chronometer escapement and electric remontoire of the present day,—all have been discarded for lack of accuracy or relegated to a subordinate position. Among the natural time-keepers of the ancients the sun-dial has given place to the "fictitious sun." Also the heliacal rising and setting of the constellations, which marked the return of the seasons, have served their day and generation, while the present seasons are regulated by the passage of the sun, through the

constantly shifting point of intersection of two imaginary circles of the celestial sphere. Today the most reliable time keeper is this same vernal equinox, a product of the mind, as it pursues its unseen course around the starry dial of the sky once in every twenty-four sidereal hours. As this point cannot be observed directly, frequent observations of the transits of the stars over the meridian, another imaginary circle, are made for time reductions. As the positions of the stars with reference to the vernal equinox are constantly changing, their places must be carefully measured, so the problem of time reckoning depends finally upon space measurement to determine corrections to be applied to the most accurate mechanical time keepers of human invention. Even this celestial clock has been suspected of change, and proof of its absolute constancy is impossible. Thus the same fundamental difficulty confronts the effort to fix a natural frame of space-coördinates and to establish a system of time reckoning,—unceasing motion; nothing is found at rest. A snap-shot of the universe is possible, but not a time exposure.

The postulate of a stationary ether pervading space and penetrating matter, but permitting bodies to pass through it undisturbed, gave new hope in the search for a satisfactory frame of reference in addition to providing a medium for the propagation of light. However, all attempts to discover any effect due to the velocity of bodies relative to this mental concept met with disappointment. The celebrated experiment of Michelson and Morley deserved success. They measured the velocity of light in the direction of the earth's orbital velocity, opposite to it and at right angles, but no difference was found; although one-fourth the effect determined on the hypothesis of a stationary ether could have been detected. This proved to be a severe strain on the mental framework designed to hold together the facts of space and time.

To reconcile the persistent failure of experiments to detect motion relative to the ether FitzGerald proposed a so-called contraction theory. If ether penetrates matter it may change the dimensions of the apparatus rotated in different directions and thus nullify the velocity effect. Lorentz showed that a contraction in the direction of velocity in the ratio

$$1 : \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}$$

was sufficient, where v is the velocity of the body and c the velocity of light. As experiments using apparatus of different materials gave the same result, a new theory of matter followed, assuming that the elementary particle, the electron, spheroidal at rest, possesses the property of contraction in the direction of its flight through the ether.

Henceforth, the failure of the Michelson-Morley and similar experiments was not an accident, but followed from the nature of the constitution of the universe. No explanation was offered to remove the fundamental difficulty, which dodged behind the electron and became inherent in the electrical theory of matter.

The admission, that the absolute velocity of a body through the ether cannot be determined by physical experiment, involves another, —no absolute standard of time and space measurement can be found. A brief consideration may help to make this clear. Let us assume the Ptolemaic system of reference, a stationary earth. Let A and B be two points at rest in that system (Ann Arbor and Boston, an apparent anachronism). Let a light signal sent from A at the instant t_1 arrive at B and be reflected at the instant of arrival t_2 and the return signal reach A at the instant t_3. Then on the assumption of the constant velocity of light c, we have

$$t_2 = \frac{t_1 + t_3}{2} ,$$

which defines two simultaneous time instants. In this way a zero for time measurement may be found for every place in the system at rest and a common unit is possible.

Now assume that A and B have a common velocity, v, in the direction AB, (west to east, Copernican system), and represent the distance AB by l, a constant for this part of the experiment as the velocity is constant. Repeat the above experiment, representing the corresponding instants of time by t_1', t_2', t_3'. Then

$$t_2' - t_1' = \frac{l}{c-v} \qquad \text{and} \qquad t_3' - t_2' = \frac{l}{c+v}$$

Eliminating l,

$$t_2' = \frac{t_1' + t_3'}{2} + \frac{v}{2c}\,(t_3' - t_1') .$$

In this case time is a function of velocity; which must be known, therefore, before time can be determined.

Applying the conclusion to axes fixed in the ether, since velocity cannot be found, time cannot be measured by an absolute unit, in other words it is not an absolute or independent conception. Likewise, space measurement, as it requires the distance between two points taken simultaneously, is dependent upon velocity; and space also loses its place as an independent concept. Two ideas here appear distinctly, the mutual relationship of space and time and the dependence of their value upon the system of coördinates adopted. This brings us near the central thought of relativity.

In 1908 Minkowski advanced the conception of space and time as a four-dimensional continuity to serve as a frame of reference. In his own words: "Henceforth time by itself and space by itself are mere shadows, they are only two aspects of a one and inseparable method of coördinating the facts of the physical world." In this system successive points occupied by the center of the sun (or any other material point) form a one-dimensional continuity called the *world-line* of the point. A light vibration set up by the sun has its world-line, which, projected on three dimensional space, becomes a ray of light. An observation consists of an intersection of world-lines; e. g., at the instant of contact of a solar eclipse, the world-line of a light vibration sent out by a point on the world-line of the sun's limb having intersected the world-line of a point on the edge of the moon strikes the world-line of the observer. Concerning the world-lines between the points of intersection, no knowledge can be obtained.

The space-time four-dimensional system of coördinates used to define physical phenomena must also express the fundamental laws of nature, which are not dependent upon the selection of one out of an infinite number of different systems. This leads to Einstein's postulate of general relativity; which, as previously stated, requires that the laws of nature must remain invariant for all transformations of coördinates.

Let the coördinates be x_1, x_2, x_3, x_4. Considering x_1, x_2, x_3 the space dimensions, x_4 the fourth dimension represents time. The length of a line measured on this system must remain unchanged when transformed to another arbitrary system x_1', x_2', x_3', x_4'. In the derivation of transformation formulae this fundamental condition is imposed, which fully determines the metric properties of the four-dimensional space-time systems involved. Similarly the laws of nature expressed as functions of the coördinates in one system become invariant.

The union of space and time in a single system and the postulate of general relativity have changed the status of gravitation from a force to something resembling a property of the four dimensions. Gravitation at a given point in a frame of reference is measured by the acceleration it produces. Suppose that a system be chosen in which the Woolworth building is at rest. Then at a given point, say in the elevator shaft, a body receives a certain acceleration. Now transform to coördinates in a descending elevator car, which at the given point possesses the given acceleration. Then with reference to the new system no gravitational effects on the body can be determined. However, according to the principle of relativity we can not choose arbitrarily between these systems. So gravitation, which is dependent upon the choice, partakes of the fundamental nature of the space-time complex. Professor W. de Sitter says: "It becomes almost a property of space." This follows

from the separation of the time coördinate from the space coördinates in the differential equations of motion in a gravitational field, which may be done by selecting the time unit for the fourth coördinate so the velocity of light is unity in free space, i.e., free from matter and gravitation; then $x_4 = ct$.

Einstein has derived a new expression for the law of gravitation which is rather complicated, involving ten equations, of which only six are independent. A first approximation neglecting terms of higher orders gives the ordinary Newtonian law. The interesting point is, however, not so much in this relationship as in the fact that these equations are the ones previously mentioned which determine the metric properties of the space-time system of coördinates.

Among the astronomical consequences pointed out, one has achieved a signal triumph. By an application of the new theory to planetary orbits an expression for the secular motion of the perihelion in the plane of the orbit was determined, which gives satisfactory agreement with the observed data, removing the long standing discrepancy between the theoretical and observed longitude of the perihelion of Mercury's orbit, which for centuries baffled the skill of the greatest mathematical astronomers and astronomical mathematicians. Seeliger succeeded in a plausible explanation on the assumption of nebulous matter surrounding the sun, but Einstein's is free from such assumption. Last fall Sir Oliver Lodge proposed an explanation based on the electrical theory of matter, and an assumption of a certain space velocity of the solar system. However the application of the same principles introduced discrepancies in the orbits of Venus and the Earth. Einstein's theory gives quite satisfactory results for the four smaller planets, and appears to be universal in its application.

As the measure of time varies with the gravitational field, the frequency of a light disturbance for a given wave-length will vary. Spectral lines of light originating in the strong gravitational field of the surface of the sun should have a displacement toward the red equivalent to 0.634 kilometers per second. The actual displacement of some solar lines toward the red appears too irregular to confirm the theory. Investigations at Mount Wilson on lines free from pressure shift failed to discover a displacement of the required order. In the case of B-type stars there is better agreement, although further evidence is needed.

Another interesting observation to test the theory awaits an opportune time. A slight deflection of a ray of light passing through a strong gravitational field has been determined theoretically. In the case of a stellar ray just grazing the sun the total double deviation due to entering and leaving the field ($-\infty$ to $+\infty$) is $1''.75$. If the separation of two

stars near opposite limbs of the sun can be measured at the time of the approaching total eclipse of the sun, June 8, 1918, either directly or by photography, the difference due to deflection by the gravitational field ought to be easily detected, as it should be nearly twice the quantity just given, depending upon the apparent distances from the sun's limb. Coronal effects may be expected to add difficulty to the observation.

The principle of relativity affords an opportunity to offer a new theory concerning the source of the sun's radiation. If energy due to velocity through space can be transformed into radiant energy, a slight negative acceleration which cannot be detected would be sufficient to provide the solar system with light and heat for unknown future aeons.

The postulate of general relativity is independent of the ether hypothesis, nor does it depend upon any theory of matter. So the ether may be bowed out of the universe it has served so long and so well, and the search for a theory of matter that will explain the nature of gravitation may continue ad finitum or ad infinitum.

Ann Arbor, Michigan.

EVENING IN SANTA CLARA VALLEY.

League upon league of orchards in the gloam—
Almond and peach-bud, prune and fragrant pear;
The sun, pine-bastioned, tips the moon-white dome
Of Hamilton aloft in cloudland fair—
Like some blown bubble of the gods at play
On high Olympus at the close of day.

The shadows deepen thro' the foothill sweep
Of tree and flower of every hue and clime;
The mitred redwoods still their vigil keep
On lone Prieta as in Christ's far time.
Against the golden glory of the west
An eaglet homeward circles to its nest.

The larks last call, the coyote's opening shriek,
A sunset gun far-echoing from the sea;
All nature sounding taps from peak to peak,
Gives o'er the vale to starland and to me.
Behold, thro' boughs all pearly petals blown,
Sirius, fused-sapphire, godlike and—alone!

C. E. Barns.

Morgan Hill, Cal.

ON SELECTING STATIONS FOR TOTALITY OF 1918, JUNE 8, AND PROBABLE CLOUD CONDITIONS AT ECLIPSE TIME.

DAVID TODD.

Although this eclipse has only a brief totality, its track of visibility lies very favorably for observation, about two-fifths of it being continuously on land; and that land being the United States from the Pacific to the Atlantic. Next to accessibility of an observing station, weather conditions have the first concern.

Professor Robert H. Baker, when an assistant at the Amherst Observatory, 1904-06, calculated the tracks of all totalities for the next two hundred and fifty years, from the best data then available. The accuracy of his calculations had been abundantly tested by the definitive data of both *American Ephemeris* and *British Nautical Almanac* for a half century (1855-1905). So it was possible for me to select the most likely stations, geographically speaking, long enough in advance to get cloud observations throughout the entire belt of totality for a series of antecedent years, not only for a full month of circum-eclipse days, each year, but at the circum-eclipse hour of each day. Accordingly observations were begun in 1912 for next summer's eclipse; also they were begun the present year in anticipation of 1925, January 24, which is also a brief morning totality at Toronto, Ithaca, Poughkeepsie, Middletown, and Nantucket.

This method of selecting eclipse stations, first tried in 1893,* has amply justified all the trouble it necessitates in selecting preliminary stations, corresponding with volunteer cloud-observers, preparing the blank forms, and discussing the returns. For instance, the initial attempt led quickly to the Lick Expedition to Chile, where Professor Schaeberle was most successful in a flawless desert sky. The Japanese astronomers followed up the method for the next totality† and I located my expedition at Esashi, in Hokkaido, in exact accord with Professor Nakamura's indications: with the result that while none of the parties in Japan got useful photographs of the corona, the clouds at Esashi were thinner than elsewhere, and even permitted our

* Todd, Data (chiefly meteorological) Bearing upon the Selection of Stations for observing The Total Eclipse of 1893, April 16, *Am. Met. Jour.* 1893, pp. 379-402.

† K. Nakamura, Guides to Observers for Solar Total Eclipse of August 9, 1896. Central Meteorological Observatory, Tokio, Japan 1896.

seeing the dim outline of the corona through them. Totality of 1898 falling in India, only slight investigation of the track was necessary; but the U. S. Weather Bureau undertook similar cloud observations in 1897-9 which were published in a series of papers * prepared by Professor Bigelow with his usual thoroughness, providing most helpful information for the intending observers. Tracks of the eclipses of 1901 1905, 1908 and 1912 were studied only fragmentarily, owing to a variety of reasons. And if the European track of 1914 had had a fuller investigation, many disappointments might have been spared, in especial that of the Lick party in Russia, where the splendid equipment and painstaking installation of Campbell and Curtis were rendered unavailing only because of insufficient meteorological data.

General Indications.

Professor W. J. Humphreys, of the U. S. Weather Bureau, on my sending him the eclipse track in 1911, expressed the opinion that Wyoming would offer the best chances of clear skies. In considerable degree, the detailed observations since made have sustained this judgment. Professor Willis L. Moore, then chief of the Bureau, transmitted copies of the published summary of climatological data for the eclipse states by sections, from which Mrs. Alice M. Swing has carefully prepared the following abstract for especial regions along the track of totality from the west eastward:

"Of Western Washington, including all the region west of the Cascade Mountains, only the southern part is eclipse area. Most of this region is wild, rugged and heavily timbered. Prevalent winds blowing over the long western coast line give this region an essentially marine climate; equable, cool in summer and mild in winter. Wet season in the winter: 8% of precipitation between October 15 and May 15; 7% of this between sunset and sunrise. Summer months generally fair; nights and forenoons cool. Precipitation very high in the coast counties, from 60 to 128 in; on the western slopes of the Cascades from 60 in. up.

"Eastern Washington. Eclipse area very small, including only portions of Yakima and Klickitat Counties. Prevalent winds blow from the west and southwest. Air currents being deflected upwards lose much of their moisture by precipitation before crossing Cascade Mountains;—hence a very dry air, clear sky and minimum precipitation. Excessive heat in summer, often reaching 100°, but not oppressive owing to dryness of air. In Yakima annual precipitation from 7 to 13 inches; in

* F. H. Bigelow, The Probable State of the Sky along the Path of Total Eclipse of the Sun May 28, 1900. Washington: Weather Bureau, 1897, 1898, 1899.

Klickitat precipitation varies from 6.5 in eastern to 25 in western portion. Summer months usually dry with occasional thunder-storms.

"EASTERN OREGON. Mostly uncultivated because of dryness and difficulties of transportation. In eclipse area are Blue Mountains,—Eagle Cap, just outside, 12,000 ft. high. Climate characterized by scanty rainfall, wide range in temperature, much sunshine and low humidity. Rain generally in thunder-storms or cloud bursts; no cyclones nor tornadoes. Mean annual temperature varies from 43° to 56°; lowest in the mountains, where freezing temperatures may occur in any month. Annual precipitation varies from 8 to 25 inches; greatest in the mountains, where as much as 50 or 60 in. may fall on windward slopes. Precipitation heaviest in winter months, but a second maximum may occur in May or June. Fog rare and humidity low.

"SOUTHERN IDAHO. Rugged region. Elevation from 2000 to 13000 ft. Drained by Snake River system. North of Snake River a section as large as Vermont is drained by rivers with no visible outlet: Big Lost River, Little Lost River, etc. Whole region largely mountains, but level along the streams. Climate varied, owing to local conditions, shut in valleys, etc. On mountains snow is seen the year round; but in general climate is milder than would be inferred from latitude and elevation. Storms rare, cold waves unknown. Diurnal range of temperature large in summer. Dryest portion along the Snake River from Shoshone to Boise. Average precipitation 7 to 10 in., minimum in July and August. During spring and summer much sunshine through this whole region; great purity and dryness of air. Valley winds light.

"WESTERN WYOMING. Region rained by rivers flowing into Pacific and Great Salt Lake. Eclipse area in southern portion extending from Continental Divide west to state boundary. Region consists of high plateaus interspersed with rugged mountain ranges including several distinct valleys. Elevation varies from 6000 ft., where Bear and Snake Rivers cross the state line, to 13000 ft. and more. Red Desert extends from Sweet Water River south to state line. Green River valley extends 150 miles north from state line; has many tributary valleys; in extreme south western portion Bear River Valley has elevation of 6000 to 7000 ft.

"Climate of *Red Desert.* Mean temperature 40°; may reach 110° in summer, but extremes are unusual. Precipitation light—perhaps 5 in. Percentage of possible sunshine very high. At Green River average number of clear days 177 annually. Waters of this desert strongly alkaline and unfit for use.

"*Valleys*. Mean temperature about 34°. Precipitation 12 to 18 in. Temperature rarely higher than 90 to 95. Summers short, and frosts liable in any month.

"*Mountains*. Records incomplete, but mean temperature low. Snowfall heavy, often remaining till June. Snowfall on highest mountains said to reach 200 feet for entire winter. Frosts common all summer.

"COLORADO, WEST OF CONTINENTAL DIVIDE, includes within eclipse area *Middle Park*, shut in on east by Front Range and west by Gore Range and drained by head waters of Grand River; *Park Range*, western wall of North Park; northern portion of Plains or Mesas west of mountains and descending to Utah Desert. Routt and Rio Blanco counties are drained by Yampa and White Rivers, tributaries of Green. Most of the rivers are perennial. Mining is the industry of mountains, stock raising of plains.

"Climate comparatively uniform due to deflection of low pressure areas. Often in winter a high pressure area is stationary over this region for days or even weeks. More cloudiness in mountains, but records not complete. Temperatures lower than in same latitude and elevation in the east, owing to heavy snow. In valleys and parks temperatures are the lowest, as air tends to stagnate. Day temperatures lower than on eastern slopes, owing to rarity of Chinook winds. Above 9000 ft; frost to be expected every month. Much sunshine in lower valleys especially in summer; greatest cloudiness in spring; at lower levels wind movement is light, toward mountains in P. M., from mountains A. M. High winds on mountain tops, generally from west. Precipitation greatest in winter and early spring; depth of snow varies from year to year, but rivers seldom fail. Sometimes 30 ft. of snow on summits.

"EASTERN COLORADO. Region drained by tributaries of the Missouri in Colorado, including mountains and high plains. Elevation decreases from 6000 ft. at Denver to 3500 ft. on Colorado-Nebraska boundary. Long's Peak 14,271 ft. is well within northern limit of totality. Passes generally 11,000 ft. and more.

"Climate of the *Plains*. Light rainfall with mean temperature of 80° between March and September. Prevalent summer winds from south and southeast, often of high velocity.

"*Foothills*. Wind less severe. Summer warm but temperature rarely reaching 100°. Rainfall 14 to 18 in. mainly in growing season.

"*Mountains*. Rainfall and windfall increases with elevation, and temperature decreases. At high altitudes precipitation reaches 40 in. mostly in winter. At lower altitudes, *e. g.*, South Park just south of eclipse line, precipitation mostly in July and August."

Specialized Observations.

I have been fortunate in enlisting Professor R. W. Porter, of the Massachusetts Institute of Technology, who has given generously of his time to the tabulation and discussion of the observations, which accumulated far beyond what I originally expected when the first appeal for volunteer observers was sent out in 1912. Here are Professor Porter's conclusions as to probabilities of a clear sky along the path of the eclipse:

"The following tables and diagrams have been prepared from the data collected by Professor Todd, bearing on the relative cloudiness of the sky near the central line of the eclipse. They represent observations covering a period of five years from 1912 to 1917 inclusive, with the exception of the year 1914. Sheets of this year are still held up somewhere in Russia or Siberia, where Professor Todd was caught at the opening of the war, and unfortunately are unavailable. The material collected is wholly meteorological, no attempt being made to determine the desirability of stations from the standpoint of clarity of atmosphere, general convenience, or ease of access, etc.

"As seen in Table III, which shows a sample of the observation blanks sent out to observers, the form includes two distinct sets of observations; that of the general state of the sky for a period of thirty days around the eclipse date, June 8, and another set at the same time each day, near the sun itself. These were taken at half hour intervals, around the hour of the day at which the eclipse is to take place at each station. The nomenclature 0, 1, 2, 3, and 4, referring to clear, ¼ cloudy, ½ cloudy, ¾ cloudy, and entirely cloudy, has been changed in the tables to percentages.

"Table I gives by years the mean values of the general state of the sky. Each number is the mean of the ninety odd observations found in the first three columns of the observation blanks, Table III. Opposite the numbers are the stations arranged in order along the path of the eclipse from west to east. The last column gives the means of the five years. Many stations, particularly east of Oklahoma, are incomplete.

TABLE I

SHOWING THE GENERAL CLOUDINESS OF THE SKY AT STATIONS ALONG THE PATH OF THE TOTAL ECLIPSE OF THE SUN JUNE 8, 1918, GIVEN BY OBSERVATIONS FROM MAY 25 TO JUNE 24 FOR THE YEARS 1912, 1913, 1915, 1916 AND 1917.

Station	1912	13	15	16	17	Mean
WASHINGTON						
Gray's Harbor	44					44
Aberdeen					45	45
Montesano	40	45	52	39	64	48
Southbend					57	57
Gate		50				50
Rochester	35	44		44	46	42
Centralia		45				49
Chehalis	42	48			35	42
Goldendale	32	32	40	22	35	32
OREGON						
Cascade Locks				53	32	42
Arlington		20	13	25	21	19
Lexington		25	34	35		31
Heppner	40	35	38	41		39
Haines	48	45	34	52	58	47
Baker		56	52	41	29	44
IDAHO						
Cambridge		28	28	28		28
Hailey		79	46	32	37	49
Pocatello		78				78
Chesterfield		56	41	30	33	40
WYOMING						
Green River	55	56	54	39		51
COLORADO						
Steamboat Springs		68				68
Estes Park		56	70	42		56
Frances	52	69	55	30	46	50
Idaho Springs	52	65	50	31	41	48
Boulder	55	65	50	32	34	47
Golden	60	68	44			57
Denver	55	78	61	48	42	57
Castle Rock		63	55	48		55
Hugo	50					50

Station	1912	13	15	16	17	Mean
KANSAS						
Coldwater	28	44	27	18	13	26
OKLAHOMA						
Alva	32	33		30	16	29
Helena	28					28
Perry			26			26
Stillwater	45	49	56	52		50
Okmulgee			31			31
ARKANSAS						
Mount Ida		24				24
Fordyce		40	45	44		43
Lake Village			38			38
MISSISSIPPI						
Canton				38		38
Quitman	52		43			47
ALABAMA						
Grove Hill			34			34
FLORIDA						
Saint Andrew					28	28
Madison			33			33
Lake City					82	82
Gainesville					62	62
Sanford					46	46
Orlando		45		55		50
Titusville					32	32
Eau Gallie					28	28
Bassenger					90	90

TABLE II.

Station	Lat.	Long.	No. of Years Covered*	Percent of Cloudiness General State of Sky	Percent of Cloudiness Sky near the Sun
	°	° ′			
Goldendale Wash.	+45.8	120 45 W	5	32	19
Arlington, Ore.	45.7	120 15	4	19	11
Lexington, Ore.	45.5	119 40	3	28	18
Cambridge, Idaho	44.5	116 40	3	28	17
Cheyenne Wells, Col.	38.8	102 20	3	29	36
Coldwater, Kan.	37.3	99 20	5	26	17
Alva, Okla.	+36.8	98 40 W	4	29	17
				27	19

"The condensed record of the seven stations showing the lowest average amount of cloudiness and covering at least three years observations is given in Table II. They are all west of Arkansas. It will be noticed that the sky seems to be about eight per cent clearer near the sun than over the entire heavens. The complete records of these very favorable stations are also submitted in Table III.

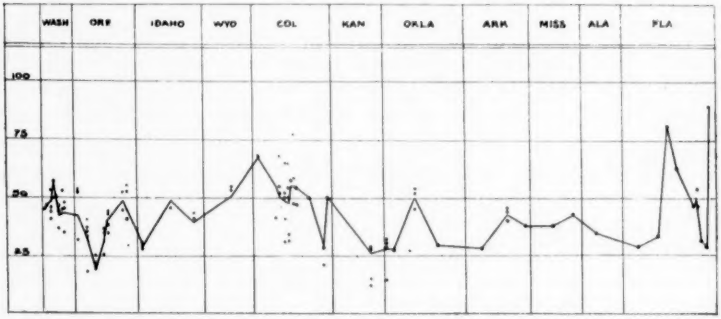


FIGURE 1.
PERCENTAGES OF CLOUDINESS GIVEN BY OBSERVATIONS AT ALL THE STATIONS.

"The percentages of cloudiness of Table I are plotted in Figure 1, the amount of cloudiness being represented by abcissae, and the relative

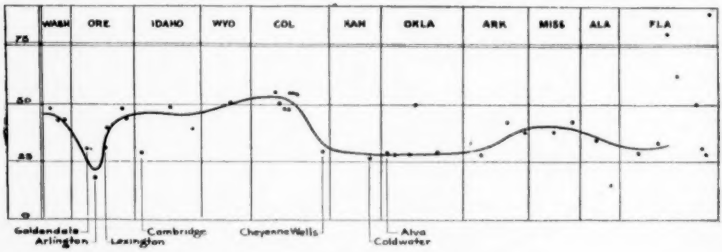


FIGURE 2.
LOWEST POINTS OF CURVE SHOW BEST EXPECTATION OF CLEAR SKY DURING TOTALITY.

positions of the stations across the States from west to east by ordinates. As will be seen, the bulk of the data covers the western states, all east of Oklahoma comprising one year periods only. The average range in the western half for the five years is about 30 per cent. The plotted mean values are connected with straight lines.

"The curve in Figure 2 is an attempt to show graphically where we may expect the least cloudiness next June. The information is taken from Figure 1. West of Arkansas only those stations whose records cover at least three years (most of them five) are plotted. The curve is a flowing one, and, with the sole exception of Cambridge, Idaho, and Stillwater, Okla., departing not over 5 per cent from the values plotted.

It is apparent from this curve that there are two regions where the sky is very much lesss cloudy in June than elsewhere. One of these is the region where the line of totality passes from the state of Washington into Oregon. The other is where it crosses from Kansas to Oklahoma. The probability of clear weather is 25 per cent better in these regions than in either Washington or central Colorado.

"In going over the mass of material which Professor Todd has accumulated at the expense of so much time and effort, the writer has been tempted at times to give undue prominence to isolated cases where the absence of clouds is quite marked. They occur for short periods only, and are flanked by stations of marked cloudiness, in some cases so near together that it is surprising that such a difference in the weather conditions could exist. The cause is probably due to local topography. He has felt it safer to stick to averages as being more likely to be of value in predicting probabilities."—R. W. P.

I have much pleasure in thanking Mr. Wm. M. Ladd (Amherst '78) of the Ladd & Tilton Bank, Portland, through whose helpful interest the summit-sunshine observations were in large part obtained.

TABLE III A.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Goldendale, Wash., by H. F. Onthrup.

Year 1912	General State of Sky P.M. 2:30	3:00	3:30	Sky near Sun P.M. 2:30	3:00	3:30	1913 General State of Sky P.M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1915 General State of Sky P.M. 2:30	3:00	3:30	Sky near Sun P.M. 2:30	3:00	3:30	1916 General State of Sky P.M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1917 General State of Sky P.M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30
May 25	4	4	4	3	3	3	0	0	0	0	0	0	4	4	4	2	3	3	Rec'd too late to record						4	4	4	3	3	3
26	2	1	1	1	0	1	0	0	0	0	0	0	4	4	3	3	3	3	3	3	3	1	1	1	3	3	3	3	3	3
27	1	1	1	0	1	0	1	1	1	1	1	1	4	4	4	3	3	3	2	2	2	0	0	0	0	0	0	0	0	0
28	4	4	4	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
29	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	2	2	2	0	1	0
30	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	1	1	1	1	1	1	0	0	0	2	2	2	0	1	0
31	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0
June 1	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	3	4	4	3	3	3
2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	4	4	4	3	3	3
3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	1	0	0	0	2	2	2	1	1	1
4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
7	1	1	1	0	1	0	3	3	3	3	3	3	0	1	1	0	1	1	0	0	0	0	0	0	2	2	2	1	0	1
8	1	1	1	1	0	1	0	0	0	0	0	0	3	3	3	2	2	2	0	0	0	0	0	0	3	3	3	1	1	1
9	0	0	0	0	0	0	3	3	3	1	1	1	1	1	1	0	0	0	1	1	1	0	0	1	2	2	2	0	0	0
10	2	2	2	1	1	1	0	0	0	0	0	0	4	4	3	3	3	0	1	1	1	0	1	0	2	1	1	0	0	0
11	4	4	4	3	3	3	0	0	0	0	0	0	4	4	4	3	3	3	0	0	0	0	0	0	3	3	3	3	3	3
12	3	3	3	2	0	2	1	1	1	1	0	1	2	2	2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
13	2	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
14	1	1	1	0	0	0	3	3	3	3	3	3	2	2	2	1	2	2	0	0	0	0	0	0	0	0	0	1	1	1
15	2	2	2	1	1	1	3	3	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	1	1	3	3	3	1	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
17	1	1	1	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	0	0	0	0	0	0
18	3	3	3	2	2	2	2	2	2	0	0	0	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
19	4	4	4	3	3	3	3	3	3	0	2	2	1	1	1	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
20	4	4	4	3	3	3	1	1	1	0	0	0	1	1	1	0	0	0	0	1	0	2	2	2	3	3	3	2	3	3
21	0	0	0	0	0	0	3	3	3	2	0	1	1	1	1	0	0	0	1	0	0	1	1	1	2	2	2	0	0	0
22	0	0	0	0	0	0	4	4	4	3	3	3	2	2	2	0	0	0	1	1	1	2	2	2	1	1	1	0	0	0
23	0	0	0	0	0	0	3	3	3	1	1	1	2	2	2	1	0	1	4	4	4	3	3	3	2	2	2	0	0	0
24	0	0	0	0	0	0	2	2	2	0	3	0	1	1	1	0	0	0	3	3	3	2	2	2	1	1	1	0	0	0

TABLE III B.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Arlington, Ore., by Lena S. Huff.

	General State of Sky P. M.			Sky near Sun P. M.				General State of Sky P. M.			Sky near Sun P. M.				General State of Sky P. M.			Sky near Sun P. M.				General State of Sky P. M.			Sky near Sun P. M.		
1913	2:30	3:00	3:30	2:30	3:00	3:30	1915	2:30	3:00	3:30	2:30	3:00	3:30	1916	2:30	3:00	3:30	2:30	3:00	3:30	1917	2:30	3:00	3:30	2:30	3:00	3:30
May 25								3	3	3	2	2	2		1	3	1	0	2	0		4	4	4	3	3	3
26								1	1	1	1	1	1		0	0	0	0	0	0		0	0	1	0	0	1
27								4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0
28	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
29	0	0	0	0	0	0		0	0	0	0	0	0		2	3	1	1	1	0		1	2	3	0	0	3
30	0	0	0	0	0	0		2	2	2	1	1	1		0	0	0	0	0	0		3	4	3	3	3	3
31	0	0	0	0	0	0		1	1	1	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
June 1	0	0	0	0	0	0		0	0	0	0	0	0		1	1	1	0	0	0		1	1	1	0	0	0
2	0	0	0	0	0	0		0	1	1	0	1	1		1	1	2	0	0	1		3	3	3	2	2	2
3	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		1	0	1	0	0	0
4	0	0	0	0	0	0		0	0	0	0	0	0		0	0	1	0	0	0		0	0	0	0	0	0
5	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
6	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
7	4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
8	4	4	4	3	3	3		1	1	3	0	0	2		0	0	0	0	0	0		1	1	1	1	0	0
9	3	4	4	0	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
10	0	0	0	0	0	0		1	1	1	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
11	0	0	0	0	0	0		0	0	1	0	0	2		0	0	0	0	0	0		1	0	3	0	0	2
12	1	3	3	0	1	1		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
13	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
14	0	0	0	0	0	0		0	1	2	0	1	2		0	0	1	0	0	0		0	2	1	0	2	1
15	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
16	1	1	1	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
17	0	0	0	0	0	0		0	0	0	0	0	0		3	4	4	2	3	3		0	0	0	0	0	0
18	1	1	1	1	0	0		0	0	0	0	0	0		3	3	3	2	2	2		0	0	0	0	0	0
19	0	0	0	0	0	0		0	0	0	0	0	0		0	1	1	0	0	0		0	0	0	0	0	0
20	0	1	1	0	0	1		0	0	0	0	0	0		1	1	1	0	0	0		1	2	3	0	2	2
21	1	2	2	0	2	2		0	0	0	0	0	0		1	1	1	0	0	0		0	0	0	0	0	0
22	4	4	4	3	3	3		0	0	0	0	0	0		1	1	2	1	1	1		3	3	3	2	2	2
23	0	1	1	0	0	0		0	0	0	0	0	0		3	3	4	2	2	3		3	2	3	2	1	2
24	0	0	0	0	0	0		0	0	0	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0

TABLE III C.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Lexington, Ore., by Nettie V. Davis

1913	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1915	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1916	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30
May 25	1	1	0	0	1	0									3	3	3	1	0	1
26	3	2	1	2	2	1									1	1	1	0	0	0
27	4	4	4	3	3	3									3	3	3	1	0	1
28	1	1	1	1	1	1									3	3	3	1	1	1
29	0	0	0	0	0	0									4	4	4	3	3	3
30	0	0	0	0	0	0									1	1	1	1	1	0
31	1	1	0	0	0	0									1	2		0	1	
June 1	0	0	0	0	0	0									1	0	2	1	1	0
2	1	1	1	0	0	0									0	0	0	0	0	0
3	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
4	3	2	3	1	1	2		2	3	3	1	2	1		4	4	4	2	3	3
5	0	0	0	0	0	0		2	2	2	0	1	0		0	0	0	0	0	0
6	0	1	1	0	0	0		0	0	1	0	0	0		0	0	0	0	0	0
7	4	4	4	3	3	3		2	2	2	0	1	0		0	0	0	0	0	0
8								3	3	3	2	1	2		0	0	0	0	0	0
9	4	4	4	3	3	3		3	2	2	2	1	1		0	0	0	0	0	0
10	1	1	1	0	0	0		2	2	3	2	1	2		0	0	0	0	0	0
11	1	1	1	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0
12	4	4	4	3	3	3		2	2	2	1	1	1		0	0	0	0	0	0
13	3	3	3	2	2	2		0	0	0	0	0	0		0	0	0	0	0	0
14	3	3	3	2	1	0		3	3	3	2	2	2		0	0	0	0	0	0
15	3	3	3	2	0	0		0	0	0	0	0	0		0	0	1	0	0	0
16	3	3	3	1	2	2		0	0	0	0	0	0		2	2	4	2	3	3
17	1	1	1	1	1	1		0	0	0	0	0	0							
18	3	3	3	1	1	1		3	3	3	2	1	1		3	2	2	3	3	3
19	4	4	4	3	3	3		0	0	0	0	0	0		3	3	3	4	4	4
20	1	1	1	0	0	0		0	0	0	0	0	0		3	3	3	4	4	4
21	4	4	4	3	3	3		0	0	0	0	0	0		3	2	2	3	3	3
22	4	4	4	3	3	3		0	0	0	0	0	0		0	0	1	0	0	1
23	4	4	4	3	3	3		0	0	0	0	0	0		3	3	3	2	3	3
24	4	4	4	3	3	3		3	3	4	1	2	2		4	4	4	3	3	3

Observations made at Lexington, Ore., by R. B. Wilcox

1913	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1915	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P. M. 2:30	3:00	3:30	1916	General State of Sky P. M. 2:30	3:00	3:30	Sky near Sun P.M. 2:30	3:00	3:30
	1	1	1	0	0	0									0	0	0	0	0	0
	0	0	0	0	0	0									0	0	0	0	0	0
	4	4	4	4	4	4									0	0	0	0	0	0
	0	0	0	0	0	0									0	0	0	0	0	0
	0	0	0	0	0	0		0	0	0	0	0	0		1	2	3	1	2	3
	0	0	0	0	0	0		0	1	1	0	0	0		1	1	1	1	1	1
	0	0	0	0	0	0		0	1	1	0	0	0		0	1	1	0	1	1
	0	0	0	0	0	0		0	1	2	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	1	1	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		2	0	0	0	0	0		0	0	1	0	0	1
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	1	0	0	1
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	2	3	4	2	3	4		0	0	0	0	0	0		0	0	1	0	0	1
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	4	4	4	4	4	4		0	0	0	0	0	0		0	0	0	0	0	0
	4	4	4	4	4	4		0	0	0	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	2	2	2	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
	2	2	2	1	1	1		0	0	1	1	0	0		0	0	0	0	0	0
	2	2	2	1	1	1		0	1	1	1	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	2	2	2	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	0	1	0	0	0		0	1	2	0	1	2
	0	0	0	0	0	0		0	0	1	0	0	0		4	4	4	4	4	4
	0	0	0	0	0	0		0	1	1	0	1	1		0	0	1	0	0	1
	0	0	0	0	0	0		0	1	1	0	1	1		0	0	1	0	0	1
	0	0	0	0	0	0		0	0	0	0	0	0		0	1	2	0	1	1
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	0	0	0	0	0	0		0	0	0	0	0	0		0	0	1	0	0	1
	0	0	0	0	0	0		0	0	0	0	0	0		3	3	3	3	3	3

PLATE VIII

Scene on the Government Trail Leading to Porcupine Forest Reserve Station in the Blue Mountains.

Sheep and Dog on a very Dusty Road.

SUMMER SCENES IN OREGON NEAR THE ECLIPSE TRACK.

PLATE IX

MR. COLVIN'S HOME IN WINTER

Hunt Mountain in the background.

PINE CREEK CANYON. LOOKING WEST AT HUNT MOUNTAIN.

Four feet of snow, well settled.

WINTER SCENES IN OREGON NEAR THE ECLIPSE TRACK.

TABLE III D.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Cambridge, Ida., by C. H. Shepherd.

Year 1913		General State of Sky P.M. 3:00	3:30	4:00	Sky near Sun P. M. 3:00	3:30	4:00	1915	General State of Sky P.M. 3:00	3:30	4:00	Sky near Sun P. M. 3:00	3:30	4:00	1916	General State of Sky P.M. 3:00	3:30	4:00	Sky near Sun P. M. 3:00	3:30	4:00
May	25	0	0	1	0	0	0		3	3	3	1	1	1		3	3	3	4	4	4
	26	1	1	2	0	0	1		1	1	1	1	1	1		1	1	1	1	1	1
	27	3	3	3	2	3	3		1	1	1	0	0	0		1	1	1	1	1	1
	28	2	1	1	1	1	1		1	1	1	0	0	0		2	2	2	1	1	1
	29	0	0	0	0	0	0		0	0	0	0	0	0		1	1	1	0	0	1
	30	0	0	0	0	0	0		1	2	2	1	1	2		1	1	1	0	0	0
	31	0	1	1	1	1	1		3	3	3	2	2	3		2	2	2	1	1	1
June	1	0	0	0	0	0	0		1	1	1	1	1	1		1	1	1	1	1	1
	2	1	1	1	1	1	1		1	1	1	0	0	0		0	0	0	0	0	0
	3	0	0	0	0	0	0		2	2	2	1	1	1		0	0	0	0	0	0
	4	1	1	1	1	1	1		0	0	0	0	0	0		2	2	1	1	0	0
	5								0	0	0	0	0	0		0	0	0	0	0	0
	6	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	7	1	1	1	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
	8	1	1	1	0	0	0		2	2	2	1	1	1		0	0	0	0	0	0
	9	¾	¾	¾	3	3	3		1	1	1	0	0	0		1	1	1	0	0	0
	10	¼	¼	¼	1	1	1		3	3	3	2	1	1		1	1	1	0	0	0
	11	0	0	0	0	0	0		3	3	3	2	2	2		1	1	1	0	0	0
	12	0	0	0	0	0	0		3	3	3	1	1	1		0	0	0	0	0	0
	13	1	1	1	0	0	0		1	1	1	1	1	1		0	0	0	0	0	0
	14	1	1	1	1	1	1		2	2	2	0	1	1		0	0	0	0	0	0
	15	1	1	1	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
	16	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	17	0	0	0	0	0	0		0	0	0	0	0	0		0	0	1	0	1	1
	18	¼	¼	¼	0	0	0		2	2	2	1	1	1		4	4	4	3	3	3
	19	¾	¾	¾	2	2	2		1	1	1	0	0	0		4	4	4	3	3	3
	20	0	0	0	0	0	0		0	0	0	0	0	0		3	3	3	2	2	2
	21	1	1	1	2	2	2		0	0	0	0	0	0		2	2	2	1	1	1
	22	4	4	4	3	3	3		0	0	0	0	0	0		1	1	1	0	0	0
	23	½	½	½	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
	24	4	4	4	3	3	3		0	0	0	0	0	0		3	3	3	2	2	2

Observations made at Cheyenne Wells, Colo., by J. W. Adams.

		1912 General State of Sky P.M. 4:00	4:30	5:00	Sky near Sun P. M. 4:00	4:30	5:00	1913 General State of Sky P.M. 4:00	4:30	5:00	Sky near Sun P. M. 4:00	4:30	5:00	1915 General State of Sky P.M. 4:00	4:30	5:00	Sky near Sun P. M. 4:00	4:30	5:00
May	25	0	0	0	0	0	0		2	3	2	0	2	1							
	26	1	1	1	1	1	2		1	1	1	1	1	2							
	27	1	1	2	1	2	2		0	0	1	1	1	1		3	3	3	2	2	2
	28	0	0	0	0	0	0		1	1	1	0	0	0		0	0	0	0	0	0
	29	0	0	0	0	0	0		0	0	0	1	1	1		1	1	1	0	1	2
	30	0	0	0	0	0	0		0	0	0	1	1	1		4	4	4	4	4	4
	31	1	2	2	2	3	3		0	0	0	0	0	0		1	1	1	1	1	1
June	1	4	4	4	4	4	4		0	0	0	0	0	0		1	1	1	1	1	1
	2	0	0	0	0	0	0		1	1	1	3	2	2		2	2	2	2	2	2
	3	0	0	0	0	0	0		0	0	0	2	2	2		4	4	4	4	4	4
	4	0	0	0	0	0	0		1	1	1	3	3	3		4	4	4	4	4	4
	5	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	6	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	7	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	8	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	9	4	4	4	4	4	4		4	4	4	4	4	4		0	0	0	0	0	0
	10	1	2	2	2	2	2		4	4	4	4	4	4		0	0	1	0	1	4
	11	4	4	4	4	4	4		4	4	4	4	4	4		0	0	0	0	0	0
	12	2	2	2	0	0	0		1	2	2	3	4	4		0	0	0	0	0	0
	13	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	14	3	3	3	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0
	15	3	3	3	2	2	0		0	0	0	0	0	0		0	0	0	0	0	0
	16	4	4	4	4	4	4		0	0	0	0	0	0		0	0	0	1	2	2
	17	4	4	4	4	4	4		0	0	0	0	0	0		0	0	0	0	0	0
	18	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	19	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	20	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
	21	0	0	0	1	1	1		2	2	2	0	0	0		1	1	1	1	2	1
	22	0	0	0	0	0	0		0	0	0	0	0	0		4	4	4	4	4	4
	23	0	0	0	0	0	0		0	0	0	0	0	0		2	2	2	4	4	4
	24	0	0	0	0	0	0		0	0	0	0	0	0		2	2	2	4	4	4

TABLE III E.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Coldwater, Kans., by Lawton Stanley.

Year 1912	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1913	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1915	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1916	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1917	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30
May 25	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
26	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
27	0	0	0	0	0	0		0	0	0	0	0	0		3	3	3	2	2	2		1	1	1	0	0	0		0	0	0	0	0	9
28	4	4	4	3	3	3		1	1	1	1	1	1		4	4	4	3	3	3		4	3	1	3	2	1		0	0	0	0	0	0
29	0	0	0	0	0	0		0	0	0	0	0	0		2	2	2	1	1	1		0	0	0	0	0	0		4	4	4	2	2	2
30	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		1	1	1	1	1	1		0	0	0	0	0	0
31	4	4	4	3	3	3		1	1	1	0	1	1		3	3	3	1	1	1		0	1	1	0	1	1		3	3	4	2	2	2
June 1	0	0	0	0	0	0		1	1	1	1	1	1		3	3	3	1	2	2		1	1	1	1	1	1		1	1	1	1	1	1
2	0	0	0	0	0	0		1	1	1	0	0	0		1	1	1	0	1	1		0	0	0	0	0	0		0	0	0	0	0	0
3	0	0	0	0	0	0		1	1	1	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0		1	1	1	0	1	1
4	0	0	0	0	0	0		2	2	2	1	1	1		1	1	1	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0
5	1	1	1	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0		0	1	1	0	1	1		0	0	0	0	0	0
6	4	4	4	3	3	3		4	4	4	2	2	2		0	0	0	0	0	0		2	2	1	2	2	1		0	0	0	0	0	0
7	0	0	0	0	0	0		1	0	0	0	0	0		2	2	2	0	1	1		0	0	0	0	0	0		0	0	0	0	0	0
8	4	4	4	3	3	3		4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
9	1	1	1	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
10	0	0	0	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
11	2	2	2					4	4	4	3	3	3		1	1	1	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
12	4	4	4	3	3	3		1	1	1	0	0	0		0	0	0	0	0	0		1	1	1	1	1	1		0	0	0	0	0	0
13	1	1	1	1	1	1		3	3	3	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
14	0	0	0	0	0	0		2	2	2	2	2	2		1	1	1	1	1	1		3	3	3	3	3	3		0	0	0	0	0	0
15	0	0	0	0	0	0		0	0	0	0	0	0		1	1	1	1	1	0		1	1	1	0	1	1		0	0	0	0	0	0
16	3	3	3	2	2	2		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
17	4	4	4	3	3	3		4	4	4	2	3	2		0	0	0	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0
18	0	0	0	0	0	0		3	3	3	2	2	2		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
19	0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0
20	0	0	0	0	0	0		4	4	4	2	3	3		0	0	0	0	0	0		0	0	0	0	0	0		2	3	3	2	2	2
21	0	0	0	0	0	0		4	4	4	1	1	1		1	1	1	0	0	0		0	0	0	0	0	0		4	4	4	2	3	3
22	3	2	2	2	2	1		0	0	0	0	0	0		4	4	4	3	3	3		0	0	0	0	0	0		0	0	0	0	0	0
23	0	0	0	0	0	0		1	1	1	0	0	0		1	1	1	1	1	1		0	0	0	0	0	0		0	0	0	0	0	0
24	0	0	0	0	0	0		3	3	3	2	2	2		0	0	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0

TABLE III F.

DETAILED OBSERVATIONS OF CLOUDINESS AT THE MOST FAVORABLE STATIONS 1912-17.

Observations made at Alva, Okla., by Lester Savage.

Year 1912	General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1913 General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1915 General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1916 General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30	1917 General State of Sky P.M. 4:30	5:00	5:30	Sky near Sun P. M. 4:30	5:00	5:30
May 25	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	1	1	0	0	1	0	0	0	0	0	0	3	4	4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
27	1	2	2	0	1	2	0	0	0	0	0	0	4	4	4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
28	4	4	4	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	3	3	3	1	2	2	0	0	1
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	3	1	1	2
30	1	1	1	0	0	0	0	0	0	0	0	0	4	4	4	3	3	3	1	2	2	1	1	2	1	1	1	0	1	0
31	2	3	3	1	2	2	0	0	0	0	0	0	2	2	3	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0
June 1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	1	1	1	1	0	0	0	2	2	2	0	2	1
4	0	0	0	0	0	0	4	4	4	3	3	3	4	4	4	3	3	3	4	4	4	3	3	3	3	3	4	2	1	3
5	0	0	0	0	0	0	0	0	0	0	0	0	3	3	4	2	3	3	4	4	4	3	3	3	2	2	2	0	0	0
6	2	3	3	2	3	3	2	2	3	2	2	3	4	3	2	3	1	0	2	3	3	1	2	2	2	1	1	1	0	0
7	1	1	2	0	0	1	1	2	2	2	2	3	3	4	4	2	3	3	1	2	2	0	0	1	0	0	0	0	0	0
8	3	3	4	2	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9	1	2	2	1	2	2	4	4	4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	2	3	3	2	3	3	0	1	2	0	0	1	2	2	1	1	1	0	0	0	0	0	0	0
11	1	1	2	0	0	1	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0
12	4	4	4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0
13	1	2	2	1	2	2	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	3	4	4	1	2	3	0	0	0	0	0	0
15	1	1	2	0	0	1	0	0	0	0	0	0	1	2	2	0	0	1	4	4	3	3	3	3	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	1	2	1	2	1	0	1	0	0	0	0	1	0	0	0
17	2	2	3	1	2	2	2	2	2	2	2	3	0	0	0	0	0	0	2	3	3	1	1	1	1	2	3	0	1	1
18	1	1	1	0	0	0	2	2	3	1	1	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	1
21	1	1	1	0	1	1	4	4	4	3	3	3	3	4	4	2	3	3	2	3	3	1	1	2	0	0	0	0	0	0
22	0	1	1	0	0	0	1	1	2	1	1	1	1	2	2	0	1	2	0	0	0	0	0	0	0	1	1	0	0	0
23	0	0	0	0	0	0	3	3	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	2	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

MOUNTAIN STATIONS.

So important is elevation above the sea on account of excessive low level absorption of the violet light of the corona, that I made especial effort to secure observations of sunshine on the summit of Mount Adams (lat. +46° 11′, long. 121° 29′ W.; elevation 12,470 ft.; 13 miles N. of central line; duration of totality 1ᵐ 57ˢ; sun's altitude 48° at 2ʰ 53ᵐ L. M. T.), also on the summit of Mount St. Helens (lat. + 46° 11′, long. 122° 9′ W.; elevation 10,000 ft.; duration of totality 1ᵐ 59ˢ; sun's altitude 49° at 2ʰ 49ᵐ L. M. T.) which is exactly on the central line.

These observers were asked to record whether the sun was or was not shining on these peaks at eclipse time each day, May 25 to June 24, and I received in all about twenty-five reports on summit sunshine as visible from the following stations:

Centralia, Wash. (J. S. Turner, 1912, 1916)
Gate, Wash. (C. L. Armstrong, 1913)
Goldendale, Wash. (H. F. Onthrup, 1916)
Hood River, Ore. (Truman Butler, 1912, 1913, 1915, 1916)
Husum, Wash. (J. R. McCracken, 1912)
North Yakima, Wash. (H. B. Scudder, 1912, 1913, 1915)
Portland, Ore. (Mrs. A. A. Eggleston, 1912)
St. Helens, Ore. (Jas. Dart, 1913, 1915, 1916)
Trout Lake, Wash. (B. R. Richter 1913, C. M. Cutting 1915, 1916)
— — — Two incomplete records 1917.

Indications are that both these mountain peaks will be well worth occupying, the percentage of summit sunshine at eclipse time being about as follows:

1912	60 per cent clear
1913	50
1915	65
1916	60
1917	55
Average	60 per cent clear

Detailed records have been deposited with Professor Frost for use of all astronomers.

U. S. Inspector Val W. Tompkins, Engineer Office, War Department, located at Cascade Locks, Oregon (lat. +35° 40′, long. 121° 54′ W., just within the southern edge of totality), contributes a complete table of cloud observations each day from May 25 to June 30 inclusive, as observed by United States Engineers at that station, 1893-1911, from which Mrs. Swing has calculated the subjoined table of percentages of clear days in the period of 37 days, for each year as follows:

1893	.486	1898	.489	1903	.180	1908	.378
4	.486	9	.324	4	.432	9	.501
5	.675	1900	.400	5	.400	10	.540
6	.700	1	.324	6	.189	11	.700
7	.189	2	·400	7	.432		

General average of these years = .432 +

Mr. Val W. Tompkins has prepared a valuable summary of early June cloudiness at Cascade Locks, Ore. (1903-13) and has been a careful observer of specific conditions at this station; also his observations of summit-shine on Diamond Peak, directly across Columbia River from Cascade Locks, indicate excellent probability of a clear eclipse from these summits. Regarding accessibility of this region, Mr. Tomkins adds, under date June 24, 1916: "Since these observations were first commenced (May 1912), some valuable developments have been accomplished in this section of the State. The U. S. Forestry Service have constructed good trails to the mountain peaks, over which pack horses can be taken, and good water and camping places are available. The Forestry Department is now engaged in constructing a trail from what is known as Eagle Creek, about 3½ miles west of this place. The trail, it is expected, will be completed this year; it will then connect with the present trail which starts from the local Forest Ranger's station about 2½ miles east of this place, on what is known as the Hermann Creek trail. This completed trail will then afford good travelling over the highest points in the mountains in this vicinity. I would suggest writing to the Official in Charge of the U. S. Forestry Service, Washington, D. C., for the latest maps of roads and trails in Oregon. The Hermann Creek trail, built by the Forestry Service, runs back over ten miles to 'Indian Mountain', which has an elevation of 4,000 feet and on its summit the Forestry Department has constructed a look-out station in which a ranger is stationed during the dry season....About 3 miles north of Indian Mountain is another mountain named 'Chinidere Mountain', with an elevation of 4,666 feet. The elevations given here are those of the U. S. Geolological Survey map 'Oregon-Washington: Mount Hood Quadrangle: Edition of March 1913.'

The eclipse track passes through a very favorable region of Oregon, and many excellent stations ought to be found in the vicinity of Baker, population about 7000. Mr. G. H. Colvin, formerly a teacher at Haines, a town of perhaps 500, has sent the accompanying photographs (Plates VIII and IX) of the country taken in October and January, and one of the Government Trail taken on a camping trip in the mountains 30 miles from the edge of the valley, in June 1915. The snow scenes give some idea of the snow-fall of the winter (1915-16) when 84 inches were recorded by the weather bureau at Baker.

"The second valuable development, the Columbia Highway, one of the grandest scenic driveways in the United States, is now paved throughout its entire length in Multnomah County, and it is hoped that in a short time this (Hood River) county end will also be paved. Thus, since 1912 this place can be reached by automobile 'from New York or San Francisco.'"

Station,—Denver, Colorado.

Sunshine (hours and tenths) for hour ending

5 P.M., May 25 to June 24, incl., 1894-1912.

		1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
May	25	0.3	1.0	1.0	0.3	0.5	0.8	0.4	0	0	0	0	0	0	0.2	0.9	0	1.0	0.8	0.9
	26	0	1.0	1.0	0.3	8	8	1.0	0.4	0	0.5	0	0.7	0.5	1.0	2	0.9	0.6	1.0	1.0
	27	0.4	1.0	1.0	0	0.6	0.1	0.9	1.0	0	0	0	0	0	0.4	2	1.0	0.7	0.8	1.0
	28	0.5	0.9	0.5	1.0	1.0	1.0	0	0.7	0.8	0.3	1.0	0	0	0	2	0	1.0	0	1.0
	29	0	0	7	1.0	1.0	0.1	1.0	0	0	6	0	0.1	1.0	0	0.6	0.4	1.0	0.1	1.0
	30	0	0	0.7	0	0	1.0	0.3	1.0	0.7	0.9	0	1.0	1.0	0.6	0	1.0	1.0	1.0	0.6
	31	0	0.3	0	0	0.4	0.3	0.8	0.9	0.8	0	0.3	1.0	0.2	0.6	0.9	0	1.0	0.4	0.4
June	1	0.6	0.6	1.0	0.7	1.0	1.0	0	0.7	1.0	0.7	0.4	1.0	0	1.0	3	0	0.1	0.7	1.0
	2	0	0	0.3	0	0.2	0.4	0.3	0	1.0	9	1.0	0	0.6	0	0.3	1.0	0.7	1.0	1.0
	3	0	0.5	0.4	0.9	0	1.0	0	1.0	0.7	0.7	0	0.3	0.5	1.0	1.0	0	0	1.0	0.7
	4	0	1.0	1.0	0.7	0.2	0	1.0	0.4	1.0	0	1.0	1.0	1.0	0.7	0.2	0	1.0	1.0	1.0
	5	0	1.0	1.0	0	0	0.9	1.0	1.0	1.0	0	0.5	1.0	0.1	0.6	0.5	0.3	0.9	1.0	0.7
	6	0.3	1.0	1.0	0.9	0	0	1.0	1.0	0.9	0	1.0	1.0	1.0	1.0	0	0	1.0	1.0	0
	7	1	0.5	1.0	3	0	0.9	1.0	0.6	0	0	0	0	1.0	0.9	0.9	0.2	0.9	0	0
	8	0.9	0.9	0.2	0.5	0.1	5	0	9	1.0	0.9	0	0.2	1.0	0	3	1.0	1.0	0.3	0
	9	1.0	0	0	0	3	0.3	0.9	9	0.4	0	0.3	1.0	1.0	1.0	9	0	1.0	1.0	0
	10	0.9	0.4	1.0	0.1	0.6	1.0	0	9	2	0	1.0	1.0	0.3	1.0	0.5	0.3	1.0	1.0	0
	11	1.0	0.7	1.0	0	0	1.0	0	0.1	6	0.3	0.5	1.0	0.4	0.2	1.0	0.9	1.0	1.0	0
	12	0.7	1.0	0	1.0	0.6	1.0	0	1.0	0.8	0	1.0	0	0	1.0	0.1	1.0	0.6	0.1	0
	13	1.0	1.0	0.2	1.0	3	0.4	0.5	1.0	1.0	0.6	0	0	0.6	1.0	0.2	0	0	0.2	0.9
	14	0.2	1.0	1.0	0	1	1.0	0.2	0	0.3	7	0	0.4	1.0	1.0	0	0.2	1.0	0	6
	15	0	0.8	0.7	0.1	0.4	1.0	1.0	0.7	0	4	0.4	1	1.0	1.0	0	0.2	0	0.8	0.3
	16	0.8	1.0	9	1.0	1.0	1.0	0.2	1.0	0	7	0	9	0	1.0	0.6	0.3	0	0	0
	17	1.0	0.7	0.4	1.0	0	1.0	1.0	1.0	1.0	5	0	9	0	1.0	0	0	0	0.8	0
	18	0.2	0.9	0	1.0	0	0	0.3	0.3	1.0	3	0	7	1.0	1.0	1.0	0	7	1.0	0.2
	19	1.0	1.0	0	1.0	0.9	0	1.0	4	0.2	5	0.6	7	0.3	0	0.4	0	0.0	0	1.0
	20	0.6	0.9	0.7	0	0	0.5	1.0	7	0	0.8	0.3	0.4	1.0	1.0	0	0.1	1.0	0	1.0
	21	0.8	0.9	0	0.6	1.0	1.0	1.0	7	1.0	0	0	0	0.8	1.0	0	7	0.5	0.6	0.1
	22	1.0	1.0	0.4	3	0	0.4	1.0	8	1.0	0.9	0.1	0.9	0	1.0	0.3	0.9	0.7	1.0	0.1
	23	0.5	0	0.6	0.9	0.1	1.0	1.0	0.9	0.4	9	0	1.0	0	3	0.9	1.0	0.9	1.0	1.0
	24	0	0.7	0	0	1.0	0	0	1.0	1.0	0.3	0.1	0.4	0.7	1.0	1.0	0.3	0	1.0	0

Regarding stations and weather in the beautiful Grande Ronde Valley, Mr. Maynard R. Thompson (Amherst '95) located at Olicel, Union Co., Ore., writes June 25, 1915: "There is always a *possibility* of a rainy spell in June; but usually our May and June weather has a great preponderance of clear bright days, with very clear air. This would be a beautiful valley to come to, and we are near La Grande, a city of 6000 or more. Mt. Emily, nearby, is easy of access, and its summit would be a good place for observation. Or if you desired a mountain that would usually be above the clouds, I think that we have such mountains within about forty miles. The mountains referred to, visible from here, are covered with snow nearly all the year. The elevation is, I believe, 7000 ft. or more. Our own Mt. Emily must be nearly 5,000 ft. above the sea. This valley is 2800 feet....During the eclipse period, this is usually the land of abundant sunshine."

Denver, a mile above sea level, is so important a station, perhaps the most accessible of all, and about eight miles from the middle of totality belt (duration of total eclipse 1m. 29 sec; sun's altitude 33°, at 4h 23m, L. M. T.) that the following resumé of observations by the U. S. Weather Bureau, furnished by Mr. Fred H. Brandenburg, District Forecaster, is most instructive (See page 182).

Many are the mountain elevations in clear Colorado air that are very favorable, both as to accessibility and eclipse location, though with a somewhat reduced altitude of the sun at totality. No systematic attempt was made to investigate their cloud conditions, but any observer who will take the trouble to made the ascent always has, with suitable optical precautions, the possibility of some such reward as favored Langley, who in 1878, from the summit of Pike's Peak, was first of all men to see the ecliptic extensions of the corona. While they are scarcely expected to be visible at the eclipse next June, other coronal extensions are quite possible which the photographic plate will fail to register. Unfortunately Pike's Peak just escapes totality, being 25 miles to the south of it; nevertheless this peak will afford a splendid vantage ground for the cosmic spectacle of the swift approach and recession of the moon's shadow, which few mortals have ever been permitted to witness.

ECLIPSE STATIONS IN OREGON AND WASHINGTON.

SIDNEY D. TOWNLEY.

During an automobile trip from Stanford University to the eastern part of Oregon last summer, I took occasion to examine several sites near the central line of the path of moon's shadow, for the eclipse of June 8, 1918.

The first place on the central line of totality that we passed through was Heppner, the county seat of Morrow County, Oregon. Heppner is located in the great central plateau of Oregon between the Cascade mountains on the west and the Blue mountains on the east. This is a semi-arid region, the landscape being made up of a succession of rolling hills of immense size. The hills are barren, the only trees being found in the canyons. Heppner is in the center of a vast wheat raising and grazing country. The town is located in a narrow canyon and may be reached by means of a branch of the Oregon-Washington Railroad and Navigation Company line, leaving the main line at Heppner Junction, about half way between The Dalles and Pendleton. Heppner is forty-five miles from the main line. The hills immediately surrounding Heppner, —several hundred feet above the town,—would certainly be fine locations from which to observe the eclipse, but there would be no shade upon them and water would not be easily obtained. There are some fairly level places in the neighborhood of the Court House that might be used. Heppner is at an altitude of 1950 feet. The population is about 1000 and there is a good hotel.

I believe the chances for clear weather at Heppner are very good. The annual rainfall for the semi-arid region is small and the summers are hot and dry. The spring rains may extend into June and there are occasional thunderstorms in July and August. Last summer was very dry in this region and there was practically no rain from April to the middle of September. We passed through Heppner on July 17, on our up trip, and the day was one of the hottest experienced during the summer.

The next place on the central line which we visited was Baker, the county seat of Baker County, Oregon. Baker is a city of between 5000 and 10,000 inhabitants and has an elevation of 3471 feet. It is located in a valley on the east side of the main range of the Blue mountains. The immediate surroundings are flat, with some small hills to the east. There are numerous good locations on the edge of town,—thebest

probably being at the Fair Grounds. These are located about one and a half miles northwest of the center of the town. The ground is level, there are buildings and sheds and city water, but no trees. The Elkhorn range of mountains, the peaks of which rise from 6000 to 9000 feet in height, lies about a dozen miles to the west of the city, the direction in which the sun will be seen at the time of eclipse. The highest of these peaks will cut off about 5 degrees of the horizon which will not be enough to interfere in any way with the observations of the sun.

Afternoon thunder storms occasionally occur in the Blue mountains during the summer months, and it is within the range of the possible that thunder clouds would be hanging over the ridge to the west of Baker at the time of the eclipse. June 8, however, is rather early in the season for thunder storms and unless the season is very early there probably will be very little danger from this source. Indeed, if the season is very late, observers might be confronted with just the opposite conditions,—a spring rain or even a snowstorm.

In 1914 I spent from May 28 to June 5 at Union, forty miles north of Baker. The weather then was really and truly "unusual" as the following notes from my diary will indicate:—May 28; "very cold, frost last night." May 29; no entry in diary concerning weather but I remember that the day was pleasant. May 30; "Much warmer." May 31; "Thunder storm over mountains in afternoon. Only a few drops of rain in valley." June 1; "Cloudy." June 2; "Thunder, lightning, hail and torrents of rain in afternoon." June 3; "Very cold." June 4; "*Snowed* from 7 a. m to 3 p. m. Melted as fast as it fell but mountains are covered. Went to Stock Show in afternoon. Wild west stunts in the mud." June 5th; "Left Union for Portland at 10 a.m. Still very cold. Arrived in Portland at 8 p. m. Raining." Snow in June is of course very unusual for that section of the country and there is very little likelihood that these conditions will be repeated in 1918.

On our return trip we passed through Heppner again on September 5, and camped that night near Rock Creek which is very near the central line of the eclipse path, and on a branch railroad which runs from Arlington to Condon. There is nothing but a cross-roads store at Rock Creek and the surrounding country is similar to that around Heppner. That night there was a thunder storm which brought the first rain in three months. When we made camp there were no signs of rain and we did not put up our tent, so we had to all scramble into the auto about 1 a.m.

From Rock Creek to Hood River we were continuously within the path of totality but did not again cross the central line. The central line crosses the Columbia River near the mouth of the John Day River

and passes near the small station of John Days. This is a rather barren region of sand and rocks but it is also the region of *least* rainfall for the states of Oregon and Washington. There is therefore perhaps a greater chance for clear weather here, on either side of the Columbia, than at any other place in the two states just mentioned. The only objection, so far as I can see, to locating near John Days, or on the north bank of the Columbia near Goldendale, is the possibility of having a sand storm. The semi-arid region of Oregon and Washington is sometimes visited by fierce winds, when the atmosphere becomes filled with dust and sand, which is very disagreeable to say the least. Any one who has traveled along this part of the Columbia River in a sand storm does not need to be told that these are not very agreeable experiences.

After reaching Portland, on our return trip, we intended to go over into Washington to Chehalis to inspect the nature of the country along that part of the line of totality, but a seven day rain made the trip inadvisable. This rain, September 7 to 13, broke a dry spell of 69 days, one of the longest ever known in Portland.

Many people have an entirely erroneous idea concerning the climate of Oregon and Washington. Oregon used to be nicknamed the webfoot state,—suggesting a country where it always rains. There are places along the coast of Oregon and Washington where the annual rainfall is from 60 to 100 inches, yet on the other hand there are places in the interior of these states where the annual rainfall is less than seven inches. The Cascade range of mountains divides these states into two parts climatically quite different. The storms come from the west and northwest. A very large percentage of the moisture is extracted by the Coast Ranges and the Cascades, still more moisture is extracted by the Blue mountains of eastern Oregon, while very little or none falls in the great plateau region between these two ranges. The vegetation of course indicates the amount of rainfall in these different regions. West of the Cascades there is a rank growth of timber and underbrush. In the Blue mountains there is also timber and underbrush but not nearly so rank as in the west. In the region between these two ranges there are vast stretches entirely devoid of timber except for a scattering growth along the creek bottoms. The summer climate of Washington and Oregon east of the Cascades is very similar to the summer climate of California. The rains continue later in the spring and begin earlier in the fall in the northern section than in the southern, but the months of June, July and August are rainless, with the exception of *occasional* thunder storms.

In the first part of this article I have spoken of the possibility of thunder storms at Heppner and Baker, but I wish to guard against the possibility of conveying the idea that these are of frequent occurrence.

There will perhaps be two or three a season and not two or three a week as in some of the eastern states. People go camping in the summer with very little thought of rain and they are seldom caught. The chances of the eclipse being obscured by a thunder storm in the region under discussion are, I think, very small.

The following table, most of the data of which were kindly furnished me by Mr. A. H. Palmer of the U. S. Weather Bureau Office of San Francisco, will give some idea of the possible weather conditions along or near the path of totality in the States of Washington and Oregon.

Station	Elevation above sea level (feet)	Average no. rainy days in June (0.01 in. or more)	Average rainfall in June (inches)	Average annual rainfall (inches)
Southbend, Wn.	——	——	3.81	89.19
Chehalis, Wn.	——	——	2.30	45.77
Lyle, Wn.	600	6	0.87	25.89
Fort Simcoe, Wn.	1427	2	0.45	——
Sunnyside, Wn.	740	4	0.36	6.65
Kennewick, Wn.	367	3	0.28	6.34
Blalock, Ore.	237	2	0.52	9.48
Umatilla, Ore.	340	4	0.40	8.43
Condon, Ore.	2891	4	1.21	11.98
Heppner, Ore.	1950	6	1.04	14.37
Pendleton, Ore.	1272	6	0.97	14.08
Baker, Ore.	3471	8	1.21	12.88

This table shows clearly the great difference in the annual rainfall on the two sides of the Cascades. Southbend and Chehalis are west of the Cascades, Lyle is on the Columbia River in the pass through the mountains and all the other places are east of the Cascades. Sunnyside is only about 180 miles east of Southbend, yet there is a difference of over 80 inches in the annual rainfall of the two places.

The sunshine records for Walla Walla, which is somewhat north of the line of totality, are as follows:

Year	Hours of sunshine in June	Percent of Possible
1914	321	68
1915	368	78
1916	307	65
1917	331	70
Average		70

These meteorological data show, I think, that there is a very good chance of clear weather on June 8 anywhere along the path of totality from Goldendale to Baker, with the chances somewhat in favor of the western end of the line. The only places accessible by railway are Goldendale, John Days, Quinns, Squally Hook, Blalock, Rock Creek, Heppner and Baker. Other places on the central line can be reached by automobile, but nothing in particular is to be gained by getting away from the railroad. John Days, Quinns, Squally Hook, and Blalock

are small stations on the main line of the Oregon-Washington Railroad and Navigation Co. line near the point where the central line of totality crosses the Columbia River.*

Each of the places mentioned above has its advantages and disadvantages, some of which have been mentioned in the first part of this article. Parties from California wishing to reach the nearest favorable location could hardly do better than to stop along the Columbia River or go to Goldendale, Washington. Parties coming from the east might well stop at Baker which may also be reached from California by automobile without going to the Columbia River region.

A SIMPLE PLAN FOR UNIFYING TIME IN THE UNITED STATES.

JERMAIN G. PORTER.

The present zone system of reckoning time has always been cumbersome and unsatisfactory, causing mistakes and delays at the junction points. It is now proposed to complicate matters still more by setting our clocks forward one hour in spring and putting them back an hour in the fall. Time is something which should be absolutely uniform and consecutive. It would be hard to conceive a much more dangerous proceeding than to arbitrarily change the time standard, for it would almost certainly cause confusion and accidents. As a war measure it might be justifiable if it would really conserve needed supplies; but as a matter of fact little will be gained by setting the time ahead during the summer only. Between the last Sunday in April and the last Sunday in September practically all the work of the country is done by daylight. If any saving of artificial light is to be effected it must be by utilizing all the daylight in winter. As it is now, the greater part of the business of the country does not begin until about two hours after sunrise, even during the shortest days of the year. Hence a great saving of daylight can be made by adopting an earlier time for the whole year.

Nor is it necessarily a greater hardship to get up early in winter than in summer. During the long nights one can easily secure plenty of sleep before the morning hours, but during the heated spells of

* According to the time table of the Oregon-Washington Railroad and Navigation Co., the names of the places John Days, Quinns, and Squally Hook, taken from an old map, have been changed to Day, Quinton, and Hook, respectively.

summer it is often impossible to get any rest early in the night, and the cool hours of morning are the most valuable for sleep.

It would, however, undoubtedly be better for the country if business were as a rule transacted somewhat earlier in the day. It is also beyond dispute that a uniform time for the transportation systems of the country is a great desideratum. Both these things can be effected in a very simple manner. Let Congress adopt ninetieth meridian time as the standard time for the whole country, except Alaska. Then let the legal hour of noon be fixed for each zone in such a way that legal noon shall in general be slightly before solar noon. Thus east of the seventy-fifth meridian the time of legal noon would be ten o'clock. Between the seventy-fifth and the ninetieth meridians legal noon would be eleven o'clock; between the ninetieth and one hundred and fifth meridians, twelve o'clock, and west of the one hundred and fifth meridian, one o'clock.

Banks and government offices would open accordingly, and other business would naturally follow, making the hours of work before the legal noon hour approximately equal to those after that period. Some confusion would inevitably result at first. People in some of the zones would have to change their time of rising, eating meals and retiring; but I believe in a very few days every one would become accustomed to the change, and the country would have the inestimable advantage of a uniform time throughout its whole territory.

Factories might find it advisable to open an hour later during the winter months. It would certainly be easy to do this without interfering with the scheme as outlined. In any event, individual convenience and preference must give way to the general good of the country. I feel confident that the system here proposed would prove a boon to the railroads and would facilitate business.

Cincinnati Observatory.

REPORT OF THE AMERICAN METEOR SOCIETY FOR 1917.

CHARLES P. OLIVIER.

The year just past marked a critical period in the history of the American Meteor Society, because directly and indirectly the war forced many of our most industrious members either to give up observing entirely or else to greatly lessen their efforts. It is therefore with considerable satisfaction that we are able to report so large a number of observations, even if this total falls much below that for 1916, and something below that for 1915. However, it is still far in excess of that secured for any year from 1911 to 1913 inclusive.

Briefly, 22 observers, working regularly on 157 nights, have reported 4231 meteors during 1917. This total also includes miscellaneous observations by several other persons. As some reports are always late in coming, there is reason to believe the figures just given will be slightly increased when these belated reports arrive.

Observer	Place	Nights	Meteors
Awde, Mrs. Willmott	Lake Mononk, N. Y.	4	111
Barnes, Robert	Wheaton, Ill.	2	33
Brooks, Donald	Washington, D. C.	36	1503
Burge, Olaf	Wichita, Kan.	1	11
Carpenter, E. F.	Melrose, Mass.	1	4
Carr, F. J.	Swanton, Vt.	3	145
Dole, R. M.	Chicago, Ill.	1	76
Hempel, Miss K. M.	Elkader, Iowa	5	14
Koep, John	Chippewa Falls, Wis.	39	1074
Kronenberger, G. F.	New York, N. Y.	2	5
La Paz, Lincoln	Wichita, Kan	3	125
Lonyo, L Foster, J. A.	Detroit, Mich.	5	107
Johnson, H. I.	Spokane, Wash.	4	342
Martin, H. H.	Fort Worth, Texas	6	49
Olivier, C. P.	University, Va.	6	168
Partello, Col. J. M. T., U. S. A.	Pacific Beach, Calif.	10	78
Pattison, Walter	Wilmette, Ill.	7	97
Pendleton, Miss W.	Bryn Athyn, Pa.	2	6
Peters, J. L.	East Holliston, Mass.	4	35
Tomkins, T. K.	N. Glenside, Pa.	12	179
Trudelle, Philip	Chippewa Falls, Wis.	4	42
Observers at L. McC. Obs.	University, Va.	—	24
U. S. Weather Bureau		—	3
		157	4231

While the work for 1917 contained no conspicuous discovery, such as that of the discovery of the connection between the May-June

meteors of 1916 and the Pons-Winnecke Comet, which was made last year, still much valuable data have been added and already partly reduced. In regard to the final publication of our work the following statements are due our members. All the results of the work of 1911-1913 inclusive have been published in final form as Part 4, Vol. 2, Publications of the Leander McCormick Observatory, University of Virginia, and distributed to everyone who had contributed any observations contained therein, as well as to all persons and institutions on the regular mailing list of this observatory. This means that every observatory of any importance in the world, and in addition a large proportion of the more prominent astronomers personally, had the work of the Society brought to their attention.

The results of 1914 and 1915, amounting to about 5500 observations, have been fully reduced and are now in manuscript ready for publication just as soon as the funds are found for so doing. The work of 1916, amounting to over 10000 observations, has been partly reduced. This reduction includes the computation of over 100 parabolic orbits of meteor streams, 9 elliptical orbits, and the preparation of several of the longer and more important tables of statistics. But a large amount of work remains to be done and many interesting facts will doubtless come from the full discussion of the data. Due to the fact that the 1916 results were still in part not worked up, those for 1917 have not as yet received much attention. However, a good start had been made and a large part of the radiants determined, though no orbits have been computed therefrom. Some of the tables have also been partly completed.

Since the 1914-1915 results have not been published as yet, it is now the plan of the author to add to them the complete results of 1916 and 1917, and have the whole appear as one publication. Since this will contain results based on 19000 meteors observed within four years, all on a uniform scientific plan, it would make the largest single contribution on the subject which has ever appeared in any country. It is needless to call to the attention of our members the desirability of this method of procedure. However, the preparation and editing of this memoir, which will fall almost entirely on the writer in addition to his other official duties, will naturally be a heavy piece of work and one requiring considerable time to finish. Everyone is again assured that his part in the work will receive full personal mention, and his results be given all the credit due them.

In further recognition of the value of the work of the American Meteor Society to astronomy, the Astronomical Society of America at its 1917 meeting promoted the author from secretary to chairman of its meteor committee, which post had formerly been so eminently filled by

the late Professor Cleveland Abbe, Sr., whose death took place during the preceding year. One of the last acts of this great American scientist was to recommend, and through his influence have published by the Smithsonian Institution, a very important paper on meteors, written originally by G. von Niessl. All members are urged to secure a copy of this excellent memoir, which was translated by Professor Abbe himself, and which everyone who really desires to make a study of the subject should certainly possess and constantly refer to. The title is "The Determination of Meteor Orbits in the Solar System." It can be obtained from the Secretary of the Smithsonian Institution, Washington, D. C., at a nominal price.

In spite of the serious conditions imposed by the war on some of our members and the smaller amount of time and energy they will be able to spend in certain cases, still it is hoped that many of the rest who will not be so affected, will take their work more seriously and go into it with a determination to secure results of value.

But it should be frankly pointed out to everyone that while we are glad to have any observations, which are accurately made, they can furnish us, no matter how few, yet it is only when an observer is willing to spend a number of consecutive hours on a given night on his work that he can reasonably expect anything of real value to come from it. Again those willing to undergo the extra discomfort of observing after midnight rather than before usually are doubly rewarded for their work, per hour spent upon it. The two members who have reported the majority of all observations sent in during 1917 both on many occasions observed from five to eight hours consecutively. It was through such hard and persevering work that they were able to report such splendid results. While the average member cannot usually be expected to do anything like this, still if each member would work just one clear night per month, from midnight on for four hours, our results would at once double, both in numbers and value. Is some approximation to this too much to ask from most of us?

As has been so often stated before, new members are always welcome, and the writer will gladly furnish equipment for meteor observing to any who are willing to undertake it, on their applying to him, and also to answer all questions to members or others who are interested in our work.

Leander McCormick Observatory,
University of Virginia.
Jan. 18, 1918.

PLANET NOTES FOR APRIL, 1918.

The sun, having crossed the equator in March, will continue its path north and east. Its course will take it from Pisces into Aries, through a region entirely devoid of bright stars.

THE CONSTELLATIONS AT 9:00 P. M. APRIL 1.

The phases of the moon for this month are as follows:

Last Quarter	Apr.	4	at 8	A.M.	C.S.T.
New Moon		10	" 11	P.M.	"
First Quarter		17	" 10	P.M.	"
Full Moon		26	" 2	A.M.	"

Mercury will be visible in the west at sunset. On April 7 it will be at its greatest distance east of the sun. After this date it will move eastward more and more slowly and by the end of the month it will have a retrograde motion, or motion to the west. On April 26 the sun will overtake it and pass it. Mercury will therefore be visible only during the first third of the month.

Venus will move eastward almost keeping pace with the sun during the month. It will however be a few hours west of the sun and will therefore rise before it and be brilliant in the morning sky throughout the month.

Mars will again engage the interest of the amateur and professional astronomer in this month. It will be a little past the point of opposition, and will be on the meridian in the evening between nine and ten. Mars did not come very close to the earth at this opposition, and will again be receding during this month. It will be on the average approximately 75,000,000 miles away. It will be a short distance southeast of Regulus.

Jupiter will still be visible in the western sky after sunset, but will be too low for good observation. By the end of the month it will set about two hours after the sun. It will be almost directly north of Aldebaran.

Saturn will be on the meridian in the early evening. It will be moving eastward slowly in Cancer. On April 28 it will be in quadrature 90° east of the sun.

Uranus will be falling back of the sun far enough to be visible in the southeast in the early morning.

Neptune will still be in the same region of the sky as Saturn. It will be in quadrature on April 24.

Satellites of Saturn, April 1918.

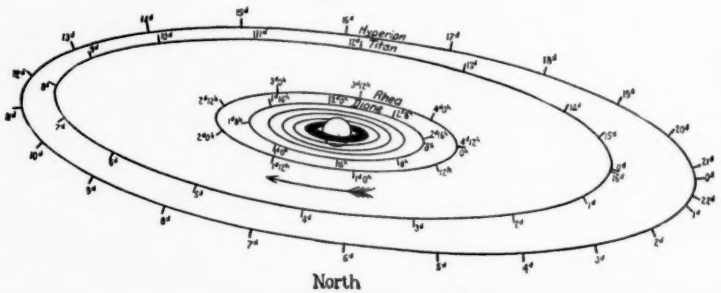
[From the *American Ephemeris.*]

CENTRAL STANDARD TIME.

I. Mimas. Period 0^d $22^h.6$.

	h		h		h		h
Apr. 1	6.8 W	Apr. 8	8.4 E	Apr. 15	10.1 W	Apr. 23	10.4 E
3	15.4 E	9	7.1 E	16	8.7 W	24	9.0 E
4	14.0 E	11	15.6 W	17	7.4 W	25	7.6 E
5	12.6 E	12	14.3 W	20	14.5 E	28	14.8 W
6	11.2 E	13	12.9 W	21	13.1 E	29	13.4 W
7	9.8 E	14	11.5 W	22	11.7 E	30	12.1 W

South



North

SATELLITES OF SATURN, 1918.

Apparent Orbits of the Seven Inner Satellites of Saturn at Date of Opposition, January 31, 1918, as seen in an inverting telescope.

II. Enceladus. Period $1^d\ 8^h.9$.

		h			h			h			h
Apr.	2	0.9 E	Apr.	8	21.4 E	Apr.	15	17.8 E	Apr.	22	14.3 E
	3	9.8 E		10	6.3 E		17	2.7 E		23	23.2 E
	4	18.7 E		11	15.2 E		18	17.6 E		25	8.1 E
	6	3.6 E		13	0.1 E		19	22.5 E		26	17.0 E
	7	12.5 E		14	8.9 E		21	5.4 E		28	1.9 E
										29	10.8 E

III. Tethys. Period $1^d\ 21^h.3$.

		h			h			h			h
Apr.	0	22.5 E	Apr.	8	11.7 E	Apr.	16	1.0 E	Apr.	23	14.2 E
	2	19.8 E		10	9.0 E		17	22.3 E		25	11.6 E
	4	17.1 E		12	6.3 E		19	19.6 E		27	8.9 E
	6	14.4 E		14	3.7 E		21	16.9 E		29	6.2 E

IV. Dione. Period $2^d\ 17^h.7$.

		h			h			h			h
Apr.	3	3.6 E	Apr.	11	8.7 E	Apr.	19	13.8 E	Apr.	27	18.9 E
	5	21.3 E		14	2.4 E		22	7.5 E		30	12.6 E
	8	15.0 E		16	20.1 E		25	1.2 E			

V. Rhea. Period $4^d\ 12^h.5$.

		h			h			h			h
Apr.	5	3.3 E	Apr.	14	4.2 E	Apr.	23	5.1 E	Apr.	27	17.5 E
	9	15.7 E		18	16.6 E						

VI. Titan. Period $15^d\ 23^h.3$.

		h			h			h			h
Apr.	6	14.3 W	Apr.	14	16.2 E	Apr.	22	13.2 W			

VII. Hyperion. Period $21^d\ 7.6^h$.

		h			h			h			h
Apr.	9	12.6 W	Apr.	19	11.1 E						

VIII. Iapetus. Period $79^d\ 22^h.1$.

		h			h			h			h
			Apr.	12	11.1 S						

IX. Phoebe. Period $523^d\ 15^h.6$.

		α Ph.—α Sat.		δ Ph.—δ Sat.				α Ph.—α Sat.		δ Ph.—δ Sat.	
		m	s	′	″			m	s	′	″
Apr.	2	−0	12.3	−1	34	Apr.	16	+0	13.9	−2	58
	4	0	8.5	1	46		18	0	17.5	3	9
	6	0	4.8	1	58		20	0	21.1	3	20
	8	−0	1.0	2	10		22	0	24.7	3	31
	10	+0	2.7	2	22		24	0	28.3	3	42
	12	0	6.5	2	34		26	0	31.8	3	53
	14	+0	10.2	−2	46		28	0	35.3	4	4
							30	+0	38.7	−4	14

Occultations Visible at Washington.

[*From the American Ephemeris.*]

Date 1918		Star's Name	Magnitude	IMMERSION. Washington M.T. h	m	Angle from N. °	EMERSION. Washington M.T. h	m	Angle from N. °	Duration h	m
Apr.	2	4 Sagittarii	4.8	15	45	53	16	59	298	1	14
	3	30 Sagittarii	6.2	12	43	52	13	35	304	0	52
	4	57 Sagittarii	6.0	15	22	36	16	18	298	0	56
	7	κ Aquarii	5.2	15	29	30	16	13	285	0	44
	13	*A* Tauri	4.5	8	31	118	9	18	243	0	47
	13	39 Tauri	6.1	8	51	137	9	27	224	0	36
	15	141 Tauri	6.3	7	5	145	8	0	242	0	55
	15	14 B Gemin.	6.0	10	39	90	11	30	295	0	51
	19	*h* Leonis	5.2	9	41	65	10	24	358	0	42
	21	p^3 Leonis	6.1	11	54	61	12	33	359	0	39
	22	13 B Virginis	5.9	14	28	92	15	28	314	1	0

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes and Franz M. Exner at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5h; Central Standard 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8			22 4					
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	2 5;	9 22;	17 14;	25 6				
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	1 7;	8 18;	16 4;	23 14				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	1 22;	9 10;	16 21;	24 8				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	4 14;	10 17;	22 23;	29 1				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	6 10;	13 13;	20 17;	27 20				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	5 17;	12 13;	19 10;	26 7				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	5 10;	12 14;	19 18;	26 22				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	2 13;	11 8;	20 3;	28 21				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	5 12;	13 10;	21 9;	29 8				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6				28 3				
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	1 3;	12 15;	24 2;	29 19				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4 8;	11 3;	17 22;	24 17				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	4 16;	12 13;	20 11;	28 9				
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	2 19;	11 3;	19 10;	27 17				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	8 10;	16 18;	24 5					
RW Persei	13.3	+42 04	8.8—11.0	15 04.8		10 9;	23 13					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	9 1;	18 12;	27 23					
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	2 5;	14 15;	27 1					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	7 9;	14 1;	20 17;	27 9				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	6 2;	14 6;	22 11;	30 15				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	5 6;	11 7;	23 8;	29 8				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	7 0;	15 16;	24 8					
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	6 5;	16 15;	27 1					
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	7 18;	15 18;	23 19					
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	2 20;	8 13;	20 0;	25 18				
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	3 20;	9 11;	20 16;	26 6				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	1 20;	10 1;	18 6;	26 10				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	7 1;	14 16;	22 6;	29 21				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	9 13		21 18					
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	3 13;	10 17;	17 21;	25 1				
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	3 14;	10 10;	24 1;	30 20				
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	5 6;	14 8;	23 15					
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	3 19;	10 10;	23 15;	30 6				
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	4 0;	12 10;	20 20;	29 5				
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	5 22;	12 8;	18 18;	25 5				
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	6 0;	13 6;	20 13;	27 19				
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	3 11;	11 14;	19 16;	27 19				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	2 12;	12 0;	21 11;	30 23				
RX Hydrae	9 00.8	− 7 52	9.1—10.5	2 6.8	4 5;	11 1;	17 22;	24 18				
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	6 12;	12 10;	24 7;	30 5				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	5 16;	12 9;	19 3;	25 21				
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	2 0;	9 10;	16 20;	24 6				
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	2 5;	8 20;	22 1;	28 15				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	3 10;	12 5;	21 0;	29 19				
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	7 12;	14 20;	22 4;	29 12				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	3 4;	9 23;	23 12;	30 7				
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	3 3;	10 15;	18 3;	25 16				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.2	4 17;	14 7;	23 21					
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	3 11;	10 22;	18 8;	25 19				
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	2 8;	9 7;	23 6;	30 6				

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 April
	h m	° ′		d h	d h d h d h d h d h
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	7 13; 14 11; 21 9; 28 6
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.3	9 19; 17 19; 26 5
SS Librae	15 43.4	−15 14	9.3—11.5	0 18.4	6 23; 14 14; 22 6; 29 22
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	1 19; 9 4; 16 12; 23 20
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	4 6; 12 12; 20 18; 29 0
R Arae	31.1	−56 48	6.8— 7.9	4 10.2	5 12; 14 9; 23 5
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	8 13; 18 6; 29 7
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	1 18; 8 13; 22 4; 28 23
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	1 0; 9 9; 17 19; 26 4
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	6 15; 12 19; 18 22; 25 2
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	1 8; 8 13; 22 23; 30 4
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	5 6; 12 15; 20 0; 27 9
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	1 19; 9 23; 18 3; 26 8
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	7 1; 14 14; 22 3; 29 16
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	6 3; 13 21; 21 15; 29 9
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	6 18; 14 17; 22 17; 30 17
WX Sagittae	53.6	−17 24	9.2—10.8	2 03.1	1 8; 9 20; 18 9; 26 21
WY Sagittae	17 54.9	−23 1	9.5—10.6	4 16.0	10 15; 19 13; 28 21
SX Draconis	18 03.0	+ 58 23	9.3—10.5	5 04.1	7 20; 18 5; 28 13
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 1.00	4 0; 11 6; 18 12; 25 18
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	5 6; 12 4; 19 2; 25 23
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2	13 9; 28 12
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	2 23; 10 3; 17 7; 24 11
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	7 12; 14 15; 21 18; 28 20
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8	2 20; 11 4; 19 11; 27 18
RR Draconis	40.8	+62 34	9.3—13	2 19.9	5 11; 13 23; 22 11; 30 23
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	5 3; 11 18; 18 10; 25 1
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	11 23; 24 20
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	6 21; 14 13; 22 4; 29 19
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	2 8; 9 22; 17 11; 25 1
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	6 3; 13 8; 20 13; 27 18
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	5 19; 14 18; 23 17
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	3 11; 10 5; 23 18; 30 12
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	6 8; 13 17; 21 2; 28 10
TT Lyrae	24.3	+ 41 30	9.3—11.6	5 05.8	5 0; 10 6; 20 17; 25 23
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	5 7; 11 20; 18 0; 24 21
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	6 6; 12 6; 24 6; 30 6
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	5 3; 11 19; 18 10; 25 1
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	3 14; 12 18; 21 21
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	1 0; 9 11; 17 21; 26 7
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	1 16; 8 11; 22 1; 28 19
UW Cygni	19.6	+42 55	10.5—10.8	3 10.8	7 15; 14 12; 21 10; 28 8
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	18 0;
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	3 9; 13 0; 22 14
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	8 16; 17 21; 27 1
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	4 4; 11 16; 19 4; 26 15
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	3 3; 10 17; 18 7; 25 22
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	7 8; 17 10; 27 13
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	2 23; 10 8; 17 18; 25 3
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	10 0; 19 17; 29 10
RY Aquarii	14.8	−11 14	8.8—10.4	1 23.2	7 19; 15 15; 23 12
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	2 21; 13 0; 23 4
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	7 12
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	1 9; 6 13; 16 22; 27 7
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.3	2 16; 11 0; 19 7; 27 14
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	4 4; 11 17; 19 6; 26 19
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	3 19; 12 1; 20 7; 28 13

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7								
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	4 11;	12 14;	20 18;	28 21				
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	4 22;	12 16;	20 10;	28 4				
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		10 22;		25 17				
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	3 5;	11 4;	19 2;	27 1				
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	4 3;	11 23;	19 18;	27 13				
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	5 1;	12 8;	19 14;	26 21				
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0		13		29				
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	5 10;	14 0;	22 14					
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	8 12;	19 15;	30 18					
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	3 4;	14 19;	26 10					
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	6 3;	13 19;	21 11;	29 2				
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3	1 11;	11 14;	21 18					
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	3 16;	11 9;	19 2;	26 19				
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	2 6;	13 8;	24 9;	29 22				
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	3 3;	10 17;	18 7;	25 20				
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3				24 2				
RT Aurigae	23.0	+30 33	5.1— 6.0	3 17.5	7 21;	15 8;	22 19;	30 6				
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	3 2;	10 7;	17 12;	24 17				
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	5 0;	12 22;	20 20;	28 18				
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	3 23;	14 3;	24 6					
RU Camelop.	7 10.9	+69 51	8.5— 9.8	12 06.5		11 10						
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	2 2;	10 0;	17 23;	25 22				
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	4 10;	11 2;	17 19;	24 12				
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	9 23;	19 5;	28 12					
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	7 15;	16 9;	25 3					
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	1 0;	7 19;	21 9;	28 4				
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	7 14;	14 5;	20 19;	27 10				
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	8 12;	18 4;	27 20					
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	7 10;	15 10;	23 9					
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	2 11;	9 5;	22 16;	29 9				
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	1 5;	12 20;	24 12;	30 8				
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	2 14;	11 23;	21 8;	30 17				
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5	5 5		22 12					
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	8 0;	16 5;	24 10					
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	3 19;	10 20;	17 20;	24 21				
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	6 10;	14 15;	22 20					
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	5 16;	11 4;	16 16;	27 15				
RS Bootis	29.3	+32 11	8.6—10.0	0 09.1	7 16;	15 5;	22 18;	30 17				
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	6 23;	14 9;	21 19;	29 4				
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	1 1;	7 20;	21 9;	28 4				
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	3 23;	10 7;	22 22;	29 6				
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	6 10;	16 4;	25 22					
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	2 2;	10 22;	19 19;	28 15				
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	4 10;	10 11;	16 13;	22 14				
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	4 4;	11 5;	18 5;	25 5				
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	4 21;		22 0					
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	7 16;	15 6;	22 20;	30 11				
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	3 6;	9 1;	20 14;	26 8				
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	2 13;	9 7;	22 18;	29 12				
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	3 9;	13 17;	24 1					
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	6 0;	12 1;	24 3;	30 3				

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. April
	h m	° ′		d h	d h d h d h d h d h
RZ Lyrae	18 39.9	+32 42	9.9—11.2	0 12.3	5 16; 11 19; 24 2; 30 5
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	6 6; 12 5; 24 2; 30 1
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	9 12; 18 14
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	5 12; 12 13; 19 13; 26 14
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	3 1; 10 1; 17 1; 24 1
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	1 13; 9 12; 17 12; 25 11
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	2 9; 10 2; 17 18; 25 11
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	3 20; 11 0; 18 5; 25 9
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	5 19; 14 4; 22 13; 30 22
X Vulpec.	19 53.3	+26 17	9.51—0.5	6 07.7	1 4: 7 12; 20 3; 26 11
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	9 6; 25 15
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	3 12; 12 9; 21 5; 30 2
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	2 22; 9 15; 23 2; 29 20
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	7 7; 14 1; 20 18; 27 11
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	12 8 27 2
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	7 16; 15 12; 23 9
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	7 7; 14 4; 21 1; 27 23
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	3 2; 12 19; 22 13; 27 10
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	6 7; 14 23; 23 14
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	4 17; 10 2; 20 20; 26 4
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	1 1; 11 22; 22 19
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	4 10; 10 20; 17 6; 30 2
V Lacertae	22 44.5	+55 48	8.5— 9.5	4 23.6	5 23; 15 23; 25 22; 30 22
X Lacertae	45.0	+55 54	8.2— 8.6	5 10.7	4 18; 10 5; 21 2; 26 13
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	3 22; 9 19; 20 16; 25 16
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	6 0; 12 7; 18 14; 24 21
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	5 15; 17 19; 29 22
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.6	5 17; 15 16; 25 16; 30 15

COMET AND ASTEROID NOTES.

New Comet (or Asteroid ?) Wolf.—A cablegram from Copenhagen to Harvard College Observatory on February 7 announced the discovery by Wolf, of Heidelberg, of an object of the eleventh magnitude, the positions of which are given below. The photographs of the object show no nebulosity so that it might be taken for an asteroid, but for its rapid eastward motion. Although it is only about thirty degrees west of the position opposite the sun, where the normal asteroid motion is retrograde, this object is moving eastward between three and four minutes in right ascension daily. Its brightness is apparently decreasing, the photographic magnitude on February 12 being not more than 13. On February 5 it was reported from Heidelberg to have a fourteenth magnitude satellite at a distance of 340″, the position angle of which was decreasing 13° hourly.

The following are all the observations which have come to hand:

Gr. M. T	R. A.	Dec.	Observer	Place
	h m s	° ′ ″		
Feb. 3.3654	6 49 08	+33 40	Wolf	Heidelberg
4.3342	6 52 48	+33 59	Wolf	Heidelberg
5.3594	6 56 09.5	+34 19 19	Wolf	Heidelberg
8.7342	7 07 34.3	+35 16 23	Wilson	Northfield
10.6957	7 14 08.3	+35 42 45	Barnard	Williams Bay
11.7695	7 17 39.9	+35 55 24	Curtis	Mt. Hamilton
12.6206	7 20 28.7	+36 04 11	Wilson	Northfield
12.7479	7 20 56.1	+36 05 19	Barnard	Williams Bay
16.5667	7 33 22.3	+36 35 14	Barnard	Williams Bay

The following is given concerning this object in Harvard College Observatory Bulletins 652 and 653:

A telegram from Professor A. O. Leuschner, Director of the Students' Observatory, Berkeley, California, communicates the following ephemeris of the object, from a parabola, computed by Jeffers, which "satisfies five places on February three, four, five, eight, eleven, except first European alpha."

G. M. T. 1918	R. A. h m s	Dec. ° ′	Light
Feb. 15.5	7 30 16	+36 11	0.71
19.5	7 43 28	+36 49	
23.5	7 56 20	+36 58	
27.5	8 8 40	+36 55	0.46

Perihelion January 14.

The following elliptical elements, computed by Stracke, have been received by cable from Copenhagen.

Epoch. February 3.500			
Mean anomaly	(M)	7°	34′
Perihelion minus node	(ω)	347	46
Longitude of node	(Ω)	110	54
Inclination	(i)	8	58
Angle of eccentricity	(ϕ)	32	12
Mean daily motion	(μ)	881″.5	

The photographic magnitude of the object, as determined at this Observatory, is 13.3 on the International Scale.

Professor E. B. Frost writes "No companion to the asteroid has been seen visually or photographically on any of the plates."

The Northfield positions are photographic, and are mean places for 1918.0.

Ephemeris of Comet *b* 1916 (Wolf).

The following ephemeris is an extension of the ephemeris given in *Lick Observatory Bulletin* 295. The elements of that bulletin referred to the ecliptic of 1918.0 are as follows:

$$\left.\begin{array}{rl} T = & 1917\ \text{June}\ 16.5373 \\ \omega = & 120^\circ\ 36'\ 01''.1 \\ \Omega = & 183\ \ 18\ \ 40\ \ .7 \\ i = & 25\ \ 40\ \ 10\ \ .3 \end{array}\right\}\ 1918.0$$

$$\log q = 0.227067$$

Constants for the equator, 1918.0:

$$\begin{aligned} x &= [9.999864]\ r \sin(\ 33\ 35\ 07.6 + v) \\ y &= [9.999683]\ r \sin(\ 303\ 38\ 24.3 + v) \\ z &= [9.658514]\ r \sin(\ 90\ 17\ 44.0 + v) \end{aligned}$$

An observation by Barnard on January 8 is represented on these elements: (O—C) $\Delta\alpha = +\ 6^s$, $\Delta\delta = -\ 0'.3$.

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

1918 Gr. M. T.		True α		True δ	Log Δ	Br.
Jan.	2.5	0h 35m 35s		— 7° 09′1	0.4688	1.14
	4.5	37 42		6 59.9		
	6.5	39 50		50.5		
	8.5	41 59		40.8	.4887	1.00
	10.5	44 09		30.9		
	12.5	46 20		20.8		
	14.5	48 32		10.5		
	16.5	50 44		6 00.1	.5135	0.85
	18.5	52 57		5 49.5		
	20.5	55 12		38.8		
	22.5	57 27		27.9		
	24.5	0 59 42		16.9	.5368	.73
	26.5	1 01 58		5 05.8		
	28.5	04 14		4 54.7		
Jan.	30.5	06 31		43.5		
Feb.	1.5	08 49		32.2	.5585	.63
	3.5	11 07		20.9		
	5.5	13 25		4 09.5		
	7.5	15 43		3 58.1		
	9.5	18 02		46.7	.5786	.55
	11.5	20 21		35.3		
	13.5	22 41		23.9		
	15.5	25 01		12.5		
	17.5	27 21		3 01.2	.5973	.48
	19.5	29 41		2 49.9		
	21.5	32 02		38.6		
	23.5	34 23		27.4		
	25.5	36 44		16.2	.6145	.43
Feb.	27.5	39 05		2 05.1		
March	1.5	41 26		1 54.1		
	3.5	43 47		43.2		
	5.5	46 08		32.4	.6303	.38
	7.5	48 29		21.6		
	9.5	50 49		11.0		
	11.5	53 10		1 00.5		
	13.5	55 30		0 50.1	.6448	.34
	15.5	1 57 51		39.9		
	17.5	2 00 11		29.7		
	19.5	02 31		19.7		
	21.5	04 51		09.8	.6579	.31
	23.5	07 11		— 0 00.1		
	25.5	09 30		+ 0 09.5		
	27.5	11 50		19.0		
March	29.5	2 14 09		+ 0 28.3	0.6698	0.28

Brightness, Jan. 8 = 1.00.

According to Professor Barnard, who observed the comet on January 8, the stellar magnitude was about the 16th.

H. M. JEFFERS.

Berkeley Astronomical Department.
February 1, 1918.

NOTES FOR OBSERVERS.

Report of the American Association of Variable Star Observers, January-February, 1918.

With this month's observations on record the total dumber of observations contributed by the Association exceeds 80000. During the past month two new members have joined ranks:—Mr. Leslie Peltier, of Delphos, O., and Mr. W. D. Binger of New York City. Mr. Binger has been commissioned Lieutenant in the Construction Division of the Signal Corps and has entered the Service. The total membership is now ninety-four.

The Secretary recently received from Father J. G. Hagen, of the Vatican Observatory, Rome, a cordial note of thanks in reply to the notification of his election to Honorary Membership in the Association. Professors E. C. Pickering and J. A. Parkhurst have also honored the Association by accepting Honorary Memberships.

Mr. Carlos Mundt of the University of California is to be congratulated on his Monograph "On the Orbit of (718) Erida" published in Number 302, Lick Observatory Bulletin.

Monsieur Houdard of the French Army, now on active duty at the Front, sent in a list of twenty-three observations of short-period naked eye variables, made during a brief furlough, which well attests his interest in the work of the Association.

Mr. Charles E. Barns of Morgan Hill, Cal., has during the past month distributed to our members a neat booklet published by himself containing in attractive form the Constitution and By-Laws of the Association and a full list of officers and members. This gift of Mr. Barns to the Association is most acceptable and greatly appreciated. In behalf of the Association the Secretary extends to Mr. Barns the hearty thanks of the organization for his generous gift. The Secretary will be glad to send a copy of this booklet to any member who failed to receive one.

During the past month copies of the Reprints of the Reports in POPULAR ASTRONOMY for 1917 have been mailed to all members. The Secretary will be glad to hear from anyone of our members who did not receive a copy.

Messrs. Bouton and Meeker, who are located in Florida for the winter, contributed exceptionally good lists of observations to this Report. The severity of this winter in the north has greatly hindered our work and prevented many from observing; thus far this year however we have maintained an average of over 1000 observations a month, which is satisfactory. The editor of POPULAR ASTRONOMY has suggested that it would favor the work of publication if our Reports did not greatly exceed this average. The Secretary will therefore, if it is necessary, omit negative observations. Observers are requested not to observe the same variable more often than twice a month. This does not apply to the irregular variables, which should be observed at every opportunity. An endeavor should be made to extend the observing list to cover variables that are little observed. In this way we can greatly increase the value and efficiency of the service rendered.

VARIABLE STAR OBSERVATIONS Jan.-Feb., 1918.

December 0 = 2421563 January 0 = 2421594 February 0 = 2421626

001032
S Sculptoris

J.D. 242	Est.	Obs.
1603.6	7.5	Me

001046
X Androm.

1596.6<11.4		V
1602.7	11.6	Me
07.6	10.5	Hu
23.5	9.0	V

001726
T Androm.

1602.7	9.5	Me

001755
T Cassiop.

1602.7	10.5	Me
13.5	9.6	B

001838
R Androm.

1603.7	11.7	Me
07.6	12.0	Hu

001909
S Ceti

1550.6	11.9	D

003159
Y Cephei

1607.6	10.5	Hu

004047
U Cassiop.

1599.6	9.7	Y
1602.5	8.8	B
02.6	8.8	Me
13.5	8.1	B

004132
RW Androm.

1603.5<12.0		B
18.5<11.5		B

004435
V Androm.

1596.6	8.9	V
1603.6	9.0	B
07.6	9.2	Hu
20.7	9.1	Me
23.6	9.0	V

004746
RV Cassiop.

1604.7<14.0		Me

004958
W Cassiop.

1604.7	10.9	Me
07.5	11.2	B

011208
S Piscium

1602.7<13.6		Me
06.6	13.0	Y
23.6<11.3		V

011272
S Cassiop.

J.D. 242	Est.	Obs.
1602.7<12.8		Me

012350
RZ Persei

1604.7	14.0	Me
10.5	12.9	Y

012502
R Piscium

1606.5	13.3	Y

014958
X Cassiop.

1599.6	12.5	Y

015354
U Persei

1550.6	8.7	D
1603.5	9.8	B
07.6	10.0	Hu
13.5	10.4	B
21.7	10.3	Me

021024
R Arietis

1604.7	11.8	Me

021403
o Ceti

1566.3	4.3	Hd
67.2	4.8	Pe
68.1	4.6	Hd
68.2	4.7	Pe
69.3	4.3	Hd
69.4	4.8	Pe
73.3	4.3	Hd
75.3	4.8	Pe
78.3	4.8	Pe
95.6	5.2	Mu
99.6	5.3	Mu
1601.6	5.3	Mu
02.7	5.3	Mu
03.6	5.4	Mu
04.7	5.3	Mu
05.6	5.4	Mu
07.6	5.2	Hu
10.6	5.4	Mu
12.6	5.4	Mu
22.7	6.2	Me
23.6	5.7	Mu

021558
S Persei

1603.5	8.8	B
18.5	9.2	B

022150
RR Persei

1610.6	11.3	Y

022813
U Ceti

J.D. 242	Est.	Obs.
1598.6<12.1		B
1606.5	12.4	Y

023133
R Trianguli

1544.4	8.9	D
99.4	11.8	B
1602.7	10.9	Mu
07.6	10.6	Hu
21.7	11.4	Me

024356
W Persei

1602.7	9.2	Mu
07.6	8.3	Hu

030514
U Arietis

1602.7	14.0	M
06.5	13.3	Y

031401
X Ceti

1602.7<10.4		Mu
07.5	10.9	M
08.7	12.0	Me

032043
Y Persei

1607.6	9.4	Hu

032335
R Persei

1602.7	8.7	Me
07.6	8.9	Hu

041619
T Tauri

1607.5	9.2	M

042209
R Tauri

1602.7<13.0		Me

042215
W Tauri

1597.5	12.6	B
1602.7<10.4		Mu
04.7	11.9	Me
07.5<11.4		M
10.5	12.5	Y
24.5<11.4		V

042309
S Tauri

1602.7<13.0		Me

043065
T Camelop.

1611.6<12.0		Wh

043274
X Camelop.

J.D. 242	Est.	Obs.
1596.5<11.7		V
1606.5	10.9	Me
11.6	11.1	Wh
23.6	9.9	V

043208
RX Tauri

1604.7	11.3	Me
13.6<12.0		Hu

044617
V Tauri

1597.5	12.7	B

045307
R Orionis

1595.6	12.5	B
1606.5	11.7	Y

045514
R Leporis

1604.7	8.6	Me
07.5	8.2	M
16.6	7.3	B

050022
T Leporis

1607.5	8.8	M
10.7	9.2	Me

050003
V Orionis

1603.7	13.5	Me
06.5	12.8	Y
11.6<12.3		Wh

050953
R Aurigae

1596.5	9.2	V
1613.5	9.6	B
20.5	9.5	B
24.5	10.1	V

052034
S Aurigae

1598.6	8.9	B
1602.7	9.9	Mu

052036
W Aurigae

1598.5	11.4	B

052404
S Orionis

1595.5	9.7	B
1616.5	7.8	B
20.5	7.6	B
23.5	7.8	D

053005 a

J.D. 242	Est.	Obs.
T Orionis		
1569.4	11.2	Pe
95.5	11.1	B
1602.7<10.2		Mu
03.7	11.6	Me
11.6	10.8	Wh
12.7	11.2	Me
13.6<12.0		Hu

053531
U Aurigae

1596.5	10.7	V
98.5	10.9	B
1610.5	10.7	Y
24.6<11.0		V

054319
SU Tauri

1569.3	9.9	Pe
76.3	10.0	Pe
95.5	9.6	B
96.6	9.5	V
97.6	9.7	B
98.6	9.6	B
99.5	9.7	B
1603.5	9.4	V
03.6	9.7	B
04.5	9.6	B
06.5	9.5	Y
07.5	9.5	B
07.5	9.8	M
09.5	9.6	B
11.7	9.7	Wh
16.5	9.5	B
18.5	9.5	B
20.5	9.5	B
21.6	9.9	Me
22.7	9.5	Me
24.6	9.4	V

054615
RU Tauri

1606.5	11.5	Y

054615a
Z Tauri

1606.5	9.7	Y

054920
U Orionis

1569.3	11.2	Pe
76.4	11.2	Pe
95.6	11.6	B
1607.5<11.0		M
13.6	11.9	Hu
21.6<11.6		Me

054974
V Camelop.

1595.6<12.2		Wh
99.5	10.5	B
1602.6<12.2		Wh
07.5<11.4		M
11.6<12.2		Wh

VARIABLE STAR OBSERVATIONS, Jan.-Feb., 1918—Continued.

055353
Z Aurigae
J.D. Est Obs.
242
1607.6 9.3 M

060450
X Aurigae
1607.6 10.0 M

060547
SS Aurigae
1550.5<11.8 D
96.6<11.4 V
99.6<11.3 Y
1602.5 10.8 Pi
02.6<10.7 Wh
03.5 10.8 Pi
03.5 11.0 V
03.6<12.4 B
03.7 10.7 Me
04.5<12.4 B
04.7 10.7 Me
06.5 10.8 Y
07.5<12.4 B
10.5<12.4 B
13.6<12.4 B
24.6<11.0 V

061647
V Aurigae
1599.5 10.0 B
1613.6 10.2 B

061702
V Monoc.
1613.6 8.4 Hu

063159
U Lyncis
1598.6 9.4 B
1610.5 9.9 Y

063308
R Monoc.
1597.6 11.5 B
1613.7 11.3 Wh

063558
S Lyncis
1618.6<11.2 B

064030
X Gemin.
1596.6 8.7 V

065111
Y Monoc.
1596.6<11.6 V
99.6 11.9 Y
1610.5 12.5 Y

065208
X Monoc.
1622.7 7.7 Me

065355
R Lyncis
J.D. Est.Obs.
242
1610.5 9.6 Y

070122a
R Gemin.
1569.4 7.7 Pe
76.4 7.9 Pe
97.6 9.3 B
1604.5 9.6 B
13.5 9.5 B
13.6 8.7 Hu
13.6 9.6 Wh
21.7 10.0 Me

070122b
Z Gemin.
1569.4<12.1 Pe
1604.5 12.3 B
13.5 12.2 B
13.6<12.1 Wh
21.7<11.1 Me

070122c
TW Gemin.
1569.4 8.3 Pe
1604.5 8.0 B
13.5 8.2 B
13.6 8.0 Wh
21.7 8.5 Me

070310
R Can. Min.
1613.6 9.6 Hu

071044
L^2 Puppis
1620.7 5.0 Me

071713
V Gemin.
1611.7 9.4 Wh
16.6 9.6 B

072708
S Can. Min.
1569.4 8.4 Pe
78.4 8.9 Pe
1612.7 10.8 Me
13.6 10.3 Wh
16.6 10.2 B
23.5<11.1 D

072811
T Can. Min.
1604.5<12.5 B

073508
U Can. Min.
1599.6 9.7 Y
1613.6 10.0 Hu
16.6 9.5 B

073723
S Gemin.
J.D. Est. Obs.
242
1595.6 9.8 B
96.6 9.8 V
1607.6 9.2 M
10.8 9.5 Me
11.7 9.4 Wh
13.5 9.8 B

074323
T Gemin.
1611.7 10.0 Wh
21.7 9.5 Me

074922
U Gemin.
1595.6<12.6 B
96.6<11.7 V
97.6<12.7 B
98.6<13.3 B
99.6<13.3 Y
1603.5<10.9 V
03.6<12.8 B
04.5<13.0 B
07.6<11.7 M
10.5<13.3 Y
11.7<12.3 Wh
13.6<12.0 Hu
16.6<12.4 B
21.7<10.9 Me

081112
R Cancri
1598.6 10.0 B
1616.6 9.1 B

081617
V Cancri
1622.7<10.8 Me

082405
RT Hydrae
1604.6 8.9 B

083350
X Urs Maj.
1604.5<12.3 B

084803
S Hydrae
1604.6 8.1 B
16.6 7.9 B

085120
T Cancri
1604.6 9.8 B

090151
V Urs. Maj.
1569.3 10.4 Pe
76.4 10.6 Pe
78.4 10.5 Pe
99.5 10.6 B

093178
Y Draconis
J.D. Est.Obs.
242
1610.5 13.4 Y

093934
R Leo. Min.
1613.6 7.4 B

094211
R Leonis
1578.4 9.6 Pe
1613.6 9.5 B

103769
R Urs. Maj.
1604.6 12.4 B

120012
SU Virginis
1613.9 10.0±M

120905
T Virginis
1613.9 9.4 M

121418
R Corvi
1609.9 7.6 M

122001
SS Virginis
1613.9 7.5 M

122532
T Can. Ven.
1613.9 10.0 M

122803
Y Virginis
1613.9<11.1 M

123160
T Urs. Maj.
1578.3 9.8 Pe
1613.9 8.2 M

123307
R Virginis
1613.9 9.2 M

123459
RS Urs. Maj.
1613.9 9.0 M

123961
S Urs. Maj.
1578.3 8.3 Pe
1613.9 9.3 M

124606
U Virginis
1613.9 8.7 M

134440
R Can. Ven.
1609.9 9.4 M

141954
S Bootis
1609.9 8.6 M

142539
V Bootis
J.D. Est.Obs.
242
1609.9 7.5 M

143227
R Bootis
1609.9<10.9 M

151731
S Cor. Bor.
1613.9 7.3 M

154428
R Cor. Bor.
1609.9 9.3 M
13.9 9.0 M

154639
V Cor. Bor.
1609.9 8.0 M

154615
R Serpentis
1613.9 10.3 M

173457
TY Draconis
1567.2 9.7 Pe

175519
RY Herculis
1565.2 10.5 Pe

180531
T Herculis
1568.2 8.4 Pe

183149
SU Draconis
1606.5<12.5 Y

193449
R Cygni
1567.2 10.1 Pe

194048
RT Cygni
1623.5<10.0 V

194632
χ Cygni
1568.2 11.8 Pe
94.5 9.5 V

195849
Z Cygni
1594.5<10.5 V
95.5 12.1 B
1603.6 11.6 Me
24.5 9.3 V

200647
SV Cygni
1599.6 8.0 Hu
1602.4 8.8 B

VARIABLE STAR OBSERVATIONS, Jan.-Feb., 1918—Continued.

200715a S Aquilae

J.D. 242	Est.	Obs.
1595.4	10.4	B

200715b RW Aquilae

J.D. 242	Est.	Obs.
1595.4	9.2	B

200938 RS Cygni

J.D. 242	Est.	Obs.
1546.6	8.4	D

200916 R Sagittae

J.D. 242	Est.	Obs.
1595.4	9.4	B

201130 SX Cygni

J.D. 242	Est.	Obs.
1601.4	<11.0	B
06.5	<13.0	Y

201647 U Cygni

J.D. 242	Est.	Obs.
1546.6	9.5	D

202946 SZ Cygni

J.D. 242	Est.	Obs.
1599.6	9.6	Hu

202954 ST Cygni

J.D. 242	Est.	Obs.
1599.6	<12.0	Hu
1606.5	<12.5	Y

203847 V Cygni

J.D. 242	Est.	Obs.
1544.5	10.4	D
95.5	9.3	B
1607.5	9.2	M

205017 X Delphini

J.D. 242	Est.	Obs.
1595.5	9.6	B

210129 TW Cygni

J.D. 242	Est.	Obs.
1606.5	<13.0	Y

210868 T Cephei

J.D. 242	Est.	Obs.
1544.5	8.0	D
99.6	5.5	Hu
1602.5	5.4	B

211614 X Pegasi

J.D. 242	Est.	Obs.
1606.5	12.2	Y

213244 W Cygni

J.D. 242	Est.	Obs.
1568.2	5.9	Pe

213678 S Cephei

J.D. 242	Est.	Obs.
1544.5	10.6	D
99.6	11.3	Hu

213753 RU Cygni

J.D. 242	Est.	Obs.
1602.5	8.4	Pi

213843 SS Cygni

J.D. 242	Est.	Obs.
1538.5	10.7	D
43.4	11.2	D
44.4	11.2	D
46.4	11.4	D
50.4	11.6	D
68.2	11.5	Pe
95.5	12.0	B
98.5	11.9	B
99.6	12.0	Hu
1601.5	11.7	B
02.5	<11.3	Pi
02.5	11.5	B
02.6	<10.9	Mu
03.5	<10.8	V
03.5	11.9	B
03.6	12.0	Me
04.5	11.3	B
06.5	11.5	Y
07.5	11.6	B
07.5	<11.3	M
12.5	<11.6	B
13.5	11.6	B
13.5	< 9.6	M
14.4	<10.2	D
16.5	<11.3	B
20.5	<11.3	B
21.4	<10.5	D

SS Cygni

J.D. 242	Est.	Obs.
21.6	11.6	Me
23.4	9.9	D
23.5	10.2	Pi
24.5	8.7	V

213937 RV Cygni

J.D. 242	Est.	Obs.
1599.6	7.8	Hu
1602.5	7.8	B

214024 RR Pegasi

J.D. 242	Est.	Obs.
1603.6	11.1	Wh

215605 V Pegasi

J.D. 242	Est.	Obs.
1595.5	11.7	B

220412 T Pegasi

J.D. 242	Est.	Obs.
1603.5	<12.4	B

225120 S Aquarii

J.D. 242	Est.	Obs.
1603.6	12.5	Me

225914 RW Pegasi

J.D. 242	Est.	Obs.
1606.5	<13.2	Y
23.5	<10.5	V

230110 R Pegasi

J.D. 242	Est.	Obs.
1568.2	9.7	Pe
1602.6	8.1	Mu
03.7	7.9	Me
06.5	8.0	Y
07.6	7.5	Hu
08.7	7.8	Me

230759 V Cassiop.

J.D. 242	Est.	Obs.
1569.4	11.2	Pe
76.3	11.6	Pe

231425 W Pegasi

J.D. 242	Est.	Obs.
1607.6	9.4	Hu

231508 S Pegasi

J.D. 242	Est.	Obs.
1578.3	9.8	Pe
1603.7	9.4	Me
07.5	9.4	B
07.6	9.2	Hu

233335 ST Androm.

J.D. 242	Est.	Obs.
1599.6	9.2	Hu
1623.5	10.2	Pi

235939 SV Androm.

J.D. 242	Est.	Obs.
1606.5	12.3	Y
23.5	11.6	Pi

No. of Observations 403; No. of Stars Observed 144; No. of Observers 12.

The following dates of Maxima and Minima calculated by Mr. Campbell are of interest:—

Date	Designation	Variable	
Mar. 9	043274	X Camelop.	Max.
9	193311	RT Aquilae	Max.
10	194048	RT Cygni	Min.
20	*204405*	T Aquarii	Min.
22	201008	R Delphini	Min.
23	154615	R Serpentis	Max.
23	235350	R Cassiop.	Max.
24	123961	S Urs. Maj.	Min.
27	123307	R Virginis	Min.

The following members contributed to this report: Messrs. Bouton, De Perrot, Ducharme, Houdard, Hunter, McAteer, Meeker, Mundt, D. B. Pickering, Vrooman, Whitehorn, Miss Young.

WILLIAM TYLER OLCOTT,
Secretary.

Norwich, Conn.
February 10, 1918.

COMMUNICATIONS.

The Beginning of the Astronomical Day.—The proposal to change the time of beginning of the astronomical day to agree with that of the civil day will involve some modifications of procedure in many of the problems of practical astronomy, which ought to be considered carefully before we decide that the change will simplify matters. At the outset, it will be agreed that inasmuch as the general public is blissfully ignorant of the existence of the astronomical day as such, it is only astronomers and navigators that are concerned in the matter.

There is no proposal to change the beginning of the sidereal day, nor the present system of right ascensions. A star comes to the meridian at the sidereal time equal to its own right ascension. This much may be taken as permanent. Probably the custom of measuring hour angle from the upper branch of the meridian will also remain with us, a star one hour west of the meridian having a positive hour angle of one hour.

On the assumption, then, that the sidereal time and hour angle are not to be altered, let us see what the proposed change will produce:

Present	Sidereal time	= Hour angle of vernal equinox,
	Mean solar time	= Hour angle of mean sun
	Sidereal time	= Mean time + Q.
Proposed	Sidereal time	= Hour angle of vernal equinox,
	Civil solar time	= Hour angle of mean sun + 12 hours,
	Sidereal time	= Civil time + Q + 12 hours

where Q is the right ascension of the mean sun, and is tabulated in the Ephemeris for Greenwich noon. I should like to find some advocate of the proposed change who will explain just how the addition of 12 hours simplifies the equations, and yet these formulae are at the basis of all time determinations, by the sun or stars, and are used in the clock comparisons at every observatory.

By using only civil time we cannot relieve the sea captain of remembering which day of the week he is sailing on, and he will always have to determine for himself whether it is morning or afternoon, whether he is east or west of Greenwich, and whether his various corrections are plus or minus. Also, it is not clear to me just how the change will avoid, in all longitudes, the possibility of mistakes of a whole day. To illustrate, let us suppose that we are using the new scheme, and that the solar ephemeris is changed to Greenwich mean midnight, the beginning of the civil day. On June 8, 1918, an observer, in west longitude 8 hours, measures the altitude of the sun, and must interpolate the sun's declination and the equation of time, in order to reduce his observation. The approximate time is 5 P. M. = 17 hours local civil time. For what Greenwich time should he make the interpolation, and is it for June 7 or June 8 at Greenwich? Any reader who is in doubt about the date and hour in this case will have to agree that changing to the civil date has simplified nothing.

Another serious objection is the change of the method of dating observations. All meridian circle observations of the stars are made with a sidereal clock, and the same is true of most observations with the equatorial. Is the observer to change his date in the middle of the night, and always keep track of the sidereal time of mean midnight? It may be granted that this change of date is at present inconvenient for observers of the sun, who often use A. M. and P. M. but they have no trouble in knowing when noon occurs.

But the chief objection in regard to dates seems to me to be the change of the Julian Day. Up to the present all astronomers agree that if we give the Julian date and fraction of a day, with the notation G. M. T., it is understood that the reckoning is from noon at Greenwich. It is now proposed to change this, and after a given year, say 1920 or later, to put in a break of 12 hours in the dating of all observations of the moon, sun, planets, comets, and stars. To be sure, a half day is not of much consequence in the proper motion of a star, or in the motion of a visual binary, but for most purposes an error of that amount is a serious matter. The proposal that every time we want to use any astronomical result of the past, we shall have to stop and consider whether or not there is a 12-hour discontinuity in the reckoning, appears to me to be absurd; and, as indicated above, the change to civil time is no simplification at all.

JOEL STEBBINS.

University of Illinois Observatory.

The Civil and Astronomical Dates.—It is my opinion that the civil dates should be employed in almanacs prepared for the use of navigators. I would not be opposed to the abandonment of the astronomical date in astronomical publications, notwithstanding unavoidable confusion, if the change could be made world wide.

R. H. CURTISS.

En résponse à la question posée mon humble avis est qu'il serait préférable de simplifier, et de commencer, par conséquent, le jour astronomique et le jour civil au même instant, c'est-à-dire à minuit, à $0^h\ 0^m\ 0^s$.

Les astronomes pensent comme les autres citoyens de cette planète, changer la date à minuit: ce n'est pas là un travail au dessus de leurs forces.

CAMILLE FLAMMARION.

Paris, Jan. 25, 1918.

A Wonderfully Beautiful Meteor.—On the night of Monday, January 28, at about 7:15, it was my good fortune to see a wonderfully beautiful meteor. It was in the south-west,—I should think azimuth about 50, and rather low in the sky. It came in front of me, directly from the east, and seemed to come almost straight across, until it disappeared in a most graceful curve in the west.

In movement it was not fast, but made a very deliberate sweep across the sky. I should judge, by careful consideration, that its passage took almost a minute.

The entire trail was a little more than five degrees long, and it was in a part of the sky that was absolutely starless at the time. Where did it belong? It evidently came from the eastern sky, but was many degrees lower than Canis Major, Orion and the eastern constellations visible at that hour.

Its nucleus was a pure white ball, not like the glittering white of Sirius, but of a more subdued white glow, and it appeared fully three times as large as Venus, which had disappeared just a short time before. The tail was a bright beautiful red, larger where it joined the head of the meteor, and tapering to a point. About a degree and a half from the end the tail was *broken* into three parts, the long one being about one degree, while the other two were small fragments following it. Where the brilliant red tail joined the nucleus there seemed a glow of colors, as if sunlight were shining through a prism. It seemed to sweep down to earth behind the houses in absolute silence.

I have seen a number of meteors and many many beautiful things in the sky above us, but this meteor of January 28 was one of the most remarkable things it

has ever been my privilege to witness. I should like to add that the nucleus of the meteor reminded me more of the dead, silvery appearance of the moon, when seen through a telescope, than anything else with which I could compare it.

JENNIE MAY WHITE.

Jacksonville, Florida.

A Bright Meteor.—A bright meteor was seen by several persons January 22 at about 6 p. m. In talking with two persons who saw the meteor I get as follows, but Larry H. Dinsch gives the most complete and accurate description. One, on his way to work, was observing Venus when he saw the bright meteor appear about 15° west of Venus, i. e., on a level with Venus, parallel with the horizon, passing under Venus in a curved line downward, and disappearing about twenty-five feet below the top of a four and one-half story building, which extended above the line from observer on a hill to the horizon. The observer says it began to break just before disappearing, for it then was shooting bright streaks downward. The trail was long, extending about $^{10}/_{12}$ of the distance from Venus to where it disappeared, and about twice the diameter of the moon in width. The meteor was bright as the planet Venus, the tail was bright also.

The meteor was visible for about four seconds. The first clear evening after consulting Mr. Dinsch was last evening. Placing myself in his position, Venus was about 17° west of the building January 22. The distance of the observer from the tall building was one fourth of a mile.

I think the above is a good description of the meteor's flight by the observers, having Venus at one end and the building at the other. Now if some astronomer from the south gets a true angle of its flight we will know quite well its height.

JUDSON W. BRUSH.

510 5th Ave., Cedar Rapids Iowa.
January 29, 1918.

Later letters from Mr. Brush add several more observations, but most of them are too crude to be used. One person at Cedar Rapids, Ia., said the meteor was "like the full moon in size"; another that it was three times as large as Venus and that the tail was the length of the handle of the Big Dipper (10°). Another, walking with back toward the meteor, saw so much light that he turned around quickly to see what it was and then saw the meteor for one or two seconds.

Mr. Fred A. Armstrong of Lawrence, Kansas, was walking due west and saw the meteor burst into view at his right and about 45° to 55° above the horizon, moving east to southeast. "It did not seem to be more than 100 feet from the ground and not to exceed 500 feet to my right . . . it did not seem to diminish in size as it departed . . . was just as much a perfect circle when it disappeared at the horizon as when I first saw it . . . sparks appeared to be coming from the tail and not from the head . . . the head seemed to be separated a few inches from the tail. The light was like a mazda or a tungsten light."

The editor of Popular Astronomy saw evidently the same meteor and noted the time of its disappearance as $5^h\ 56^m \pm 30^s$, Central Standard Time. The reason of the uncertainty in time is that it was too dark to see distinctly the seconds hand of the watch, and there was no street lamp near at hand. The meteor was a little brighter than Venus, the head very deep blue, throwing off red sparks and trail. The course was at an angle of about 45° with the horizon, descending toward the left and intersecting the horizon at about 20° west of south. The meteor disappeared behind a building when perhaps a half degree high. A moment later the light from its explosion was seen reflected from some low lying, and perhaps very distant, clouds.

Newspaper clippings which have been sent in indicate that the meteor passed almost due eastward over St. Joseph, Missouri, and that a fragment

of it fell in the eastern outskirts of that city. From Peoria, Ill., the meteor was seen in the northwest, while from Kansas City it was seen to fall toward the northeast.

Judging from all these reports the meteor must have fallen in fragments scattered over the northwestern part of Missouri.

An article and diagram, sent in by Professor D. W. Morehouse too late to be inserted in this number of Popular Astronomy, give reports of observations of the meteor from many points in Iowa, Kansas and Missouri.

The Meteor of January 22, 1918.—Numerous accounts have appeared in the papers of the great meteor which was seen over Iowa and Missouri the evening of Tuesday January 22, 1918, but the descriptions of its path have been inaccurate and contradictory. Through the interest of Mrs. Francis Strain, one of my students, I was brought in touch with Mr. S. L. Close, of this city, who happened to be in the open at the time the meteor fell, looking directly at the part of the sky where it appeared, and who carefully noted the beginning and end of the path with respect to good marks, so that I have been able to take a sextant to the place and measure the angles with satisfactory acccuracy.

The meteor appeared at a point directly west, and at altitude 23°. It moved slowly to the south and downwards, and burst at a point at altitude 1°, and azimuth 53° south of west. When about 3° above the horizon it passed through or behind a layer of cloud, and reappeared under it before bursting.

The fall occurred about two or three minutes before 6:00 P. M., C. S. T. The motion was rather slow, so that at least ten or twelve seconds was consumed. The meteor was strongly red in color, and of great brightness, so that it seemed as big as the full moon. A trail, shading off from red to pink, was left behind, and lasted about five or six seconds, so that at any time it covered about half the total path. Mr. Close heard no noise.

The latitude of Iowa City is 41° 40′, and longitude $6^h\ 6^m\ 9^s$.

I shall be glad to receive or to see published accurate observations made at other places, so as to determine the path in space. A newspaper account states that a piece fell at St. Joseph, Mo.

O. H. Truman.

24 Physics Building.
Iowa City, Iowa.

Meteoric Observations for 1917.—For the year 1917 I have observed 1074 meteors during a period of eleven months from January to November, getting out on one or more nights for each month. The total time spent for observing was 108 hours and 48 minutes. The average for this period would be one meteor every 6.08 minutes. The result for magnitude and color are as follows:

	Magnitudes.						
Meteors	>0	0	1	2	3	4	5
	87	42	90	145	198	233	279

	Color.						
Meteors	W	B	R	G	Y	O	V
	571	354	124	13	12	0	0

The initials stand for the first letter of the color.

The display from the Lyra stream of meteors was very good—most of them large and blue, leaving no trails. They appeared far from the radiant. On April 21, they came at the rate of 12.5 meteors per hour, and on the 22nd of April, 10 per

hour. The Pons-Winnecke stream showed very little activity. This was possibly because the meteors are small and the moon was nearly full at the date of maximum.

On February 8, at 10 p. m. I saw a large meteor about one-half the size of the moon. It was low in the western sky and traveled very slowly. This meteor was variable in its light. It faded out until it was invisible and then brightened again and disappeared. The moon was full at the time. Meteors seen in the western sky were generally large and their paths long, while they traveled slowly. Only one stationary meteor was seen during the year.

Meteoric work is partly interesting because you can never tell when a good display will come along. One may come unexpectedly some day and it would be well worth the trouble to see it. The great war keeps us so busy that less time can be spent getting regular meteor observations. That only makes the observations more valuable, because spare time is worth more, when it is divided by two kinds of work: War work and Scientific work. Meteoric astronomy is almost a new branch of astronomy in America, and it is up to amateur and professional astronomers to make it a lasting branch. Mr. Charles P. Olivier, of the University of Virginia, has done a great deal to advance this branch by organizing the American Meteor Society, of which I am a member, and by giving as much of his time to it as possible, also by publishing very valuable articles on the subject. I should like very much to correspond with any persons interested in the subject, who live either in this or neighboring states, and see whether some plan of coöperative observing could be devised.

JOHN KOEP.

Chippewa Falls, Wis.

The Recent Frigid Weather.—In these times of unprecedented occurrences, when scarcely a week passes without registering some shocking or record breaking event, we have experienced a spell of weather which, so far as anybody seems able to remember, has never been equalled for severity on this continent.

Temperatures have ranged for protracted periods, over districts never before called upon to meet such extremes, from 86 below zero to zero.

It is natural to inquire why this has happened, and what explanation may be advanced to account for it. To clearly visualize the severity of this visitation it is interesting to compare elevation tests of temperature; at a height of 18 miles the thermometer has recorded 97° below zero. This suggests the cold of outer space, about which we have reached certain conclusions; but this temperature is only about 11° lower than that recorded at Dawson recently.

In seeking a solution it is natural to turn first to the sun, as the source of all our heat and energy. In the daily routine it is strangely true that few of us stop to realize what would happen if our present relations with this nearest star should suddenly terminate and the question arises could any diminution of the sun's heat output account for what has happened, in conjunction with the fact that about the same time the sun's efficiency, owing to position, was at minimum. It is certainly conceivable that such a combination might produce serious consequences.

Suppose we consider some of the known facts concerning the sun's radiation of heat, and the possibility that there was some modification during the recent week of frigidity.

In the first place any change from normal, to be appreciated, must have been protracted, for we are told the rate of radiation does sometimes vary in a few days as much as 10%, but it would require a considerable period of change to make even

this substantial variation perceptible. If however it did persist, the temperature of the earth would be changed about 13°. While on the face of it this does not seem much of a heat loss, it might easily account for the very thing that occurred, particularly in the light of recent measurements which prove conclusively there are distinct fluctuations of solar radiation, sometimes extending over a period of several months. True enough these measurements and observations have not yet reached a point where the effects of variation can be accurately determined on the earth's climate, owing to the extremely complex nature of the problem involved and the many points to consider, but the mere fact that it is certainly known there are periods when the sun radiates less heat than at others, must undoubtedly have some bearing on the phenomenal condition we are discussing. Besides, the presence of sunspots affords another interesting point for consideration. On the first of January a line of spots stretched clear across the sun's equator. As many as a dozen large and small ones could be counted. The question as to whether or not sunspots affect the sun's emission of radiation is approached guardedly by the authorities, but we do know they create at times magnetic storms of great violence, accompanied by brilliant auroral displays after which much cooler weather prevails, and finally, in connection with various phenomena associated with sunspot conditions, not the least in its relation to these remarks, is the conclusion reached by certain astronomers that the earth's temperature during sunspot activity is on the whole lower than at other times.

If then we take the two known factors that prevailed during our week of exceptional temperature, namely, the sun's orbital position of least efficiency, and the great sunspot activity, it is fair to assume, even without the backing of actual measurements, that a period of variability also prevailed during which the solar heat emission was below normal.

S. C. HUNTER.

New Rochelle, N. Y. January, 1918.

GENERAL NOTES.

Dr. Frank Schlesinger, director of the Allegheny Observatory, has accepted appointment as Aeronautical Engineer in the Signal Corps. He will have charge of the instruments that are mounted on aeroplanes and will form the connecting link between the construction department of the Service and the National Research Council. During his temporary absence from the Observatory, Dr. Frank C. Jordan will be in charge.

Professor David Todd, director of the Amherst College Observatory, has been given leave of absence and is at Miami, Florida, engaged in work in connection with the war. In spite of this he has found time to prepare the very useful article "On Selecting Stations for Totality of 1918, June 8, and Probable Cloud Conditions at Eclipse Time," which is printed in this number of POPULAR ASTRONOMY.

Mr. Paul S. Yendell, the wellknown observer of variable stars, died recently at his home at Dorchester, Mass, at the age of seventy-three years. He was a veteran of the civil war and has never been in very robust health since that service. He has been working for the past three or four years in preparing for publicaton his long series of variable star observations.

Mr. John Evershed has been awarded the gold medal of the Royal Astronomical Society (England) for his contributions to astrophysics.

Professor Frederick Slocum, of the department of astronomy at Wesleyan University, has taken up nautical work for the Government and will not return to college this year. (*Science* Feb. 22, 1918).

Notes from Lick Observatory.—From a private letter we learn that the weather has been very fine on Mount Hamilton this winter up to January 10 when the first rain came. There had been no snow at all. The observers have had their fill of observing lately. There were many nights in December when the temperature in the dome in the morning hours was from 50° to 58°.

This is very different from the conditions at Northfield. Here there has been hardly a clear night when the temperature was not below zero.

From the same letter we learn that Director Campbell's older sons are "somewhere in France," the one a lieutenant in the Engineers and the other in the aviation service. Dr. Curtis' oldest son is in the radio service on the "Rhode Island," "somewhere on the Atlantic."

A New Star in Monoceros.—A cablegram received at this Observatory from Professor Elis Stroemgren, Director of the University Observatory, Copenhagen. Denmark, states that Wolf, of Heidelberg, on February 4, photographed a star with the spectrum of a nova, in R. A. $7^h\ 22^m\ 30^s$, Dec. $-6°\ 32'$. Its magnitude was eight and a half.

The Harvard photographs show that this object follows $-6°\ 2109$, $0^m.3$, in nearly the same declination. Its position for 1900 is accordingly R. A. $7^h\ 21^m.9$, Dec. $-6°\ 29'$. Its photographic magnitude was 5.4 on January 1, 8.9 on February 4, 9.0 on February 17, 1918, and it appears on plates taken on numerous intermediate dates. On December 22, 1917, it was not seen, and was fainter than magnitude 9.8.

This is the first bright nova that has appeared since 1912.

EDWARD C. PICKERING.
Director.

Harvard College Observatory, Bulletin 653.
Cambridge, Mass., U. S. A. Feb. 21, 1918.

Journal des Observateurs.—The editor, M. Henry Bourget, of the French paper *Journal des Observateurs*, published at 29-31 Rue Sainte, Marseilles, France, asks us to announce that at the end of each year that paper will publish the "approximativ" ephemerides of the Algol type stars for the next year, and at the beginning of the year "accurate" ephemerides of all variables, in order to facilitate the reduction of observations made in the past year. M. Luizet, of the Lyons Observatory, will be in charge of the necessary computations.

M. J. Mascart, director of the Lyons Observatory, announces that he is quite ready to prepare all needful ephemerides of variables for observers who ask him for them.

Stellar Parallaxes.—Volume IV, Part I, of the Publications of the Yerkes Observatory, which has recently come to hand, contains the detailed results of the photographic determination of the parallaxes of 85 stars. Forty-two of these were determined by Frederick Slocum and S. A. Mitchell, seventeen by Oliver J. Lee and Alfred H. Joy and twenty-six by Oliver J. Lee and Georges Van Biesbroeck. The

probable errors are in most cases below 0″.010. It is interesting to find the parallaxes of the components of 61 Cygni determined separately:

	π
61_1 Cygni	$+0''.267 \pm 0''.004$
61_2 Cygni	$+0\ .277 \pm 0\ .006$

The range of the probable errors is just enough to bring the two results together by using the + sign for the first and the − sign for the second.

The well known double-double star ϵ Lyrae is probably very distant, the parallaxes coming out

	π
ϵ^1 preceding	$-0''.003 \pm 0''.005$
ϵ^1 following	$-0\ .007 \pm 0\ .009$
ϵ^2 preceding	$+0\ .006 \pm 0\ .010$
ϵ^2 following	$+0\ .012 \pm 0\ .008$

The stars in the trapezium in the Orion Nebula are evidently farther away than the reference stars, of about the ninth magnitude, with which they were compared, since the parallaxes found are negative.

	π
A	$-0''.014 \pm 0''.009$
B	$-0\ .026 \pm 0\ .010$
C	$-0\ .021 \pm 0\ .010$
D	$-0\ .023 \pm 0\ .007$

It is question whether the nebulous matter does not cut off the light of stars more distant than it, and if so the stars in the field photographed would be either this side of the nebula or involved in it. The trapezium stars are almost certainly involved in the nebula and so would naturally be beyond the stars which are not connected with it.

Photographs of Nebulae.—In the *Astrophysical Journal*, July 1917, Mr. Francis G. Pease has published some wonderful photographs of nebulae, taken with the 60-inch reflector of the Mount Wilson Observatory. Reproductions of photographs are given for 35 nebulae. The exposures range from five minutes to seven hours. The majority of these nebulae are spiral in structure but there are several planetary nebulae in which the spiral form cannot be detected. In some there appear to be rings, perfect in form but broken up into patches of unequal density. In two or three the rings or spirals do not appear to be in the same plane.

The paper is published separately as "Contributions from the Mount Wilson Solar Observatory" No. 132.

Cincinnati Observatory Publication No. 18.—This contains Part III of the Catalogue of Proper Motion Stars, including those stars whose right ascensions are between 15^h and 24^h. An appendix gives about 90 stars for which proper motions have been found after parts of the catalogue had been printed, so that the catalogue is brought closely up to date. No preface is printed but a note states that Part IV will contain the tabulated results, together with the magnitudes, precessions, secular variations, proper motions on a great circle, and position angles.

Velocity of the Magellanic Clouds.—From a private letter dated December 11, 1917, we learn that spectrograms of seventeen out of twenty gaseous nebulae in the region of the Magellanic clouds have been obtained at the D. O. Mills Observatory, Santiago, Chile, and that all of these indicate high velocity, comparable with the first velocities obtained in 1915 (about 275 km for the greater cloud.

See POPULAR ASTRONOMY Vol. XXIII, p. 255). Two of the remaining nebulae are so faint as to preclude the possibility of guiding on them and so have been removed from the observing program. The third is doubtful but the observers expected to attempt to obtain a spectrogram of it.

Spectrographic Binaries γ Phoenicis and σ Puppis.—In the *Lick Observatory Bulletin* No, 303, Dr. Ralph E. Wilson gives orbits of the spectroscopic binary stars γ *Phoenicis* and σ *Puppis* based upon measures of spectrograms obtained with the 37-inch reflector of the D. O. Mills Expedition at Santiago Chile, during the years 1903-1917, and spectrograms obtained at the Cape Observatory in 1905-1915. Thirty-one spectrograms were available for the first star and fifty-one for the second.

ELEMENTS.

	γ Phoenicis	σ Puppis
$P =$	193.79 days	257 days
$T =$	J. D. 2417945.0	2420418.6
$e =$	0.005	0.17
$\omega =$	267°	349°.3
$K =$	15.8 km	18.55 km
$V_0 =$	+ 25.8 km	+ 87.3 km
$\mu =$	1°.8577	1°.3964
$a \sin i =$	42,000,000 km	64,800,000 km
$\frac{m_1^3 \sin^3 i}{(m+m_1)^2} =$	0.079 ⊙	0.164 ⊙

A Spectroscopic Study of κ Pegasi.—In the *Lick Observatory Bulletin* No. 304 Mr. F. Henroteau, a Belgian who now holds the Martin Kellogg Fellowship at at the Lick Observatory, gives the results of a very thorough study of the available spectrograms of the star κ *Pegasi*. This star is a very close visual double, having one of the shortest known periods (11.37 years). The two components are of practically equal brightness, magnitude 5.0, and one of the two has been found to be a spectroscopic binary with a period of about 6 days, so that the star is really a triple system of great interest.

Mr. Henroteau has computed three orbits of the spectroscopic components, using spectrograms obtained in 1900, 1912 and 1917. The elements of the three orbits are brought together in the following table:

Epoch	1900.7	1912.7	1917.6	Probable errors for 1917
K	39.81 km	40.35 km	41.53 km	±0.34 km
e	0.04	0.03	0.034	±0.007
ω	4°.7	47°.5	189°.4	±13°.9
P	5^d.9715	5^d.9715	5^d.9715	...
T	J.D. 2415239.25	2419593.17	2421440.69	± 0.23
γ	−2.80 km	−3.79 km	−14.62 km	...
$a \sin i$	3,266,000 km	3,312,000 km	3,408,000 km	±19,000 km

It is noticeable at once that the velocity (γ) of the system has changed. This was to be expected because of the revolution of the visual components around each other in 11 years. The longitude of periastron (ω) has also changed, which indicates a rotation of the line of apsides. Mr. Henroteau thinks it probable that the line of apsides rotates 360° in the same time that the spectroscopic body revolves around the center of mass of the system, that is, in 11.35 years.

By making various reasonable assumptions Mr. Henroteau is able to calculate the semi-major axis of the spectroscopic orbit as 511,100,000 km and that of the apparent orbit of one of the visual components around the other as 1,826,000,000 km. The parallax comes out 0″.025, and the masses of the visual components 3.71⊙ and 6.62⊙, the latter being the spectroscopic binary. These are, however, very uncertain.

Navigation, A New Course in Astronomy.—A course in navigation, by Professor R. H. Curtiss, will be offered in the Department of Astronomy of the University of Michigan for the second semester of the present college year. This course is planned primarily to enable students who are interested in nautical service to prepare themselves in Navigation, as a part of their college work.

The course will include the principles of Piloting, Dead Reckoning, and Nautical Astronomy, with appropriate observatory practice; also the rules of the road at sea, principles of general seamanship, and signaling according to the International Code. For the benefit of those enrolled in the Naval Reserves, especial stress will be laid on the subjects under Navigation covered in the Reserve Officers' Training Camps in preparation for Ensigns' examinations. Also consideration will be given to the additional topics included in the curricula of the Free Navigation Schools of the United States Shipping Board.

In a letter dated February 13, Dr. Curtiss says that 108 students have enrolled in this course.

The Nearest Star.—Heretofore we have called α *Centauri* the nearest star, but now we will have to give that position to a faint star near α *Centauri* which is apparently moving through space with the latter but somewhat nearer to us. This star was referred to in a note on p. 556, Vol. XXV of POPULAR ASTRONOMY. In *Circular* No. 40 of the Union Observatory, South Africa, Mr. Innes gives the result of a determination of the parallax, from micrometric observations connecting the star with an 11.7 magnitude star 30″ distant. From these measures alone the resulting parallax is 0″.802, but Mr. Innes combines this with the result obtained by Dr. Voute 0″.755 and another value 0″.796, obtained from the ratio of the proper motions of this star and α *Centauri*, and adopts for the final parallax 0″.782.

The Distances, Absolute Magnitudes and Spectra of 734 Stars arranged for use with ordinary star maps by Thomas Edward Heath, F. R. A. S. William Wesley & Son, 28 Essex Street, Strand, London, England, Price 2s 6d net.

This is an interesting and valuable pamphlet, of about fifty pages, in which Mr. Heath has gathered together the data which have been obtained concerning the stars whose parallaxes have been determined. He has divided the sky into 80 divisions of approximately equal area and arranged the stars in the order of right ascension in each division. It is thus easy to see how nearly uniform in all parts has been the survey of the heavens for stellar parallax. A great lack of data is revealed for the southern hemisphere, there being only two measured stars within 25° of the south pole and only forty-two in the zone from −20° to −65° declination.

Mr. Heath uses as his unit of distance, that of a star whose parallax is 0″.1, which corresponds to 32.6 light-years. At this distance the sun would be of magnitude 5.00 and Vega of magnitude 0.0. He defines the absolute magnitude of a star as its apparent magnitnde as seen from the unit distance or 32.6 light-years. He gives the sun-power of each star, the unit being the quantity of light which would be given by the sun if it were removed to the unit distance of 32.6 light-years, assuming its present apparent magnitude to be −26.57.

An interesting result of this study is the fact that 62 per cent of the stars for which parallaxes have been determined are brighter than the sun, while 38 per cent are fainter, the absolute magnitudes of all ranging from +7.0 to −6.6. The brightest stars appear to be Canopus (sun-power 44650) and Rigel (sun-power 14932), but

these figures are very uncertain, the measured parallaxes of both stars being 0″.007 ± 0″.010. About all that can be said with certainty is that their sun-power is extremely large, perhaps larger than here given.

Mr. Heath suggests that much satisfaction may be obtained by marking the spectral type, absolute magnitudes and light years, beside each star on one's star map, as fast as these data become available, and thus watching the progress of our knowledge of the structure of the heavens.

Astronomical Constants.—The "Companion to the Observatory" for 1918 gives the following list of astronomical constants, which we have thought might be of interest to our readers and convenient to have grouped together in this form.

ASTRONOMICAL CONSTANTS.

Astronomical Unit	149,400,000 km; 92,850,000 miles.
Solar Parallax	8″.80.
Moon's Equatorial Parallax	3422″.63.
Moon's Mass	1÷81.53.
Equatorial Radius of Earth	6378200 metres; 20926000 feet.
Ellipticity of Earth	1÷297.
Sidereal Year	365.25637 days }
Sidereal Month	27.32166 days } Mean solar time.
Sidereal Day	$23^h\ 56^m\ 4^s.090$ }
Constant of Precession (1900)	50″.2564.
Constant of Nutation	9″.21.
Constant of Aberration	20″.47
Constant of Gravitation	6.66×10^{-8} C.G.S. units.
Earth's Orbital Speed	29.76 km per sec.; 18.49 miles per sec.
Velocity of Light	299860 km; 186330 miles per sec.
Doppler displacement; 1 tenth-metre at Hγ (λ 4340.6)=	69.1 km per sec.
Pole of the Milky Way	R. A. $12^h\ 48^m$, Dec. + 27°.
Vertex of Star-streaming	R. A. $6^h\ 16^m$, Dec. + 12°.
Solar Apex	R. A. $18^h\ 2^m$, Dec. + 34°.
Solar Motion	19.5 km per sec.
Light-year	5.9×10^{12} miles.
Parsec (distance for 1″ parallax)	19.2×10^{12} miles.
Light Ratio for 1 magnitude	2.512. ...
Sun's Stellar Magnitude	$-26^m.5$.
Sun's Absolute Magnitude	$5^m.1$ (at 10 parsecs distance).
Solar Constant	1.932 gram-calories per sq.cm. per minute.
No. of Square Degrees in the Sky	41,253.

The Largest Telescope.—The following is from *Punch* (London) of December 5.

"The largest telescope in the world has just been erected at the Mount Wilson Observatory in California. Enthusiasts predict that the end of the war will be clearly visible through it."